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02 AIRCRAFT

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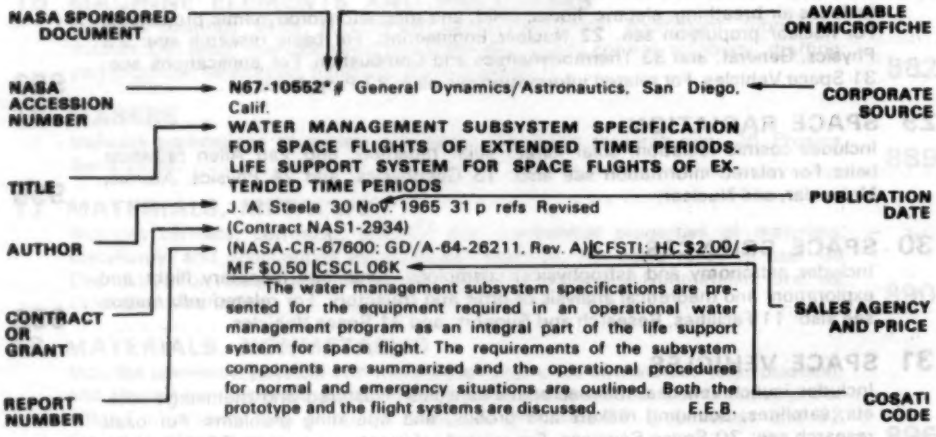
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N67-10552*# General Dynamics/Astronautics, San Diego, Calif.
CORPORATE SOURCE
WATER MANAGEMENT SUBSYSTEM SPECIFICATION FOR SPACE FLIGHTS OF EXTENDED TIME PERIODS. LIFE SUPPORT SYSTEM FOR SPACE FLIGHTS OF EXTENDED TIME PERIODS
TITLE
PUBLICATION DATE
J. A. Steele 30 Nov. 1965 31 p refs Revised
AUTHOR
(Contract NAS1-2934)
(NASA-CR-67600; GD/A-64-26211, Rev. A)
CFSTI: HC $2.00/ MF $0.50
CSCL 06K
SALES AGENCY AND PRICE
CONTRACT OR GRANT
The water management subsystem specifications are presented for the equipment required in an operational water management program as an integral part of the life support system for space flight. The requirements of the subsystem components are summarized and the operational procedures for normal and emergency situations are outlined. Both the prototype and the flight systems are discussed.
E.E.B.
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VOLUME 5 NUMBER 6

Scientific and Technical Aerospace Reports

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March 23, 1967

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N67-15368# Technische Hogeschool Twente, Enschede (Netherlands).

ON THE SHAPE DESIGN OF PROJECTILES

P. J. Zandbergen *In* AGARD The Fluid Dyn. Aspects of Ballistics 1966 p 117–146 refs (See N67-15361 06-12) CFSTI: HC $3.00/MF $0.65

A discussion is given of the theoretical aspects of a number of factors influencing the design of projectiles. These include the Magnus effect, base drag, the determination of normal forces, and the minimization of wave drag. Only brief remarks are made about the first two subjects, while the last two are considered in more detail, especially the minimization of wave drag. This because of the fact that they are more dependent on the shape of the projectile, and moreover since rather new and interesting methods have been forwarded. Especially for the minimum wave drag shapes remarkable results have been obtained, consisting of whole families of low wave drag shapes. Author

N67-15369# Ecole Royale Militaire, Brussels (Belgium).

THE MATHEMATICAL MODELS OF THE TRAJECTORY OF A SHELL [LES MODELES MATHEMATIQUES DE LA TRAJECTOIRE D'UN OBUS]

P. Godfrind *In* AGARD The Fluid Dyn. Aspects of Ballistics 1966 p 147–165 In FRENCH; ENGLISH summary (See N67-15361 06-12) CFSTI: HC $3.00/MF $0.65

The ballistic trajectory calculated from a mathematical model is discussed. Until now, experts in ballistics have used a so-called mathematical model of the material point, which is simplified to a great extent. The trajectory of the shell can be calculated by means of such a model if one considers only the resistance of the air parallel to the velocity of the center of gravity of the shell, and gravity, which are two forces exerted on the center of gravity. A few years ago, force and moment measurements were very inaccurate; therefore, it was obviously not adequate to introduce in the equations small forces which were poorly known. At present, aerodynamic tunnel measurements of such forces and of the corresponding moments are much more accurate. Author

N67-15370# Institut Franco-Allemand de Recherches, St. Louis (France).

PERTURBATION EFFECTS ON ROCKETS

H. Molitz *In* AGARD The Fluid Dyn. Aspects of Ballistics 1966 p 167–180 ref (See N67-15361 06-12) CFSTI: HC $3.00/MF $0.65

The accuracy of unguided rockets is influenced by several errors such as incorrect thrust alignment, imbalances, and especially a cross-wind. Considerations of the simultaneous effects of the principal errors give the optimum values for stability and rate of spin. As a result of the various errors the behavior of flight seems, at first glance, to be almost homogeneous; a more careful consideration reveals, however, some typical characteristics, which in their turn, can also be used for the analysis of trajectory measurements. Such an evaluation is demonstrated by an example (PARCA). The principal source of error in the case of lateral dispersion is the effect of a cross-wind. Using the extended Didion equation it is shown that several methods can be applied in order to reduce appreciably the effect of the wind, e.g., to ensure that the first phase in the flight of the rocket will be unstable. A final remark refers to the so-called ballistic wind; its definition is no longer valid in all cases. Author

N67-15371# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Porz (West Germany).

THE INFLUENCE OF AERODYNAMIC PARAMETERS ON THE DISPERSION OF UNGUIDED ROCKETS DUE TO GUSTS

N. Treinies and E. H. Hirschel *In* AGARD The Fluid Dyn. Aspects of Ballistics 1966 p 181–210 refs (See N67-15361 06-12) CFSTI: HC $3.00/MF $0.65

The powered part of the flight path of an unguided rocket influenced by a variable cross wind and thrust malalignment is calculated on a digital computer. The magnitude of the deviation caused by distinct disturbances depends on the aerodynamic data of the missile. The optimum yaw oscillation distance decreases with increasing frequency of the cross wind. Author

N67-15372# Ballistic Research Labs., Aberdeen Proving Ground, Md.

REVIEW OF BASE DRAG

R. Sedney *In* AGARD The Fluid Dyn. Aspects of Ballistics 1966 p 211–240 refs (See N67-15361 06-12) CFSTI: HC $3.00/MF $0.65

A review of the present state of knowledge of axisymmetric base drag is given. With application to ballistics in mind, this review is especially concerned with supersonic flight and turbulent boundary layers. Correlations of base pressure are discussed as

well as some analytical methods of attacking the problem; no satisfactory analytic theory exists. Experimental methods of determining base pressure in wind tunnels and ballistic ranges are discussed. The effect of a boattail on total drag and base pressure is discussed and one other method of reducing base drag is considered briefly. Author

N67-15373# Army Missile Command, Huntsville, Ala.
AN EMPIRICAL TECHNIQUE FOR ESTIMATING POWER-ON BASE DRAG OF BODIES-OF-REVOLUTION WITH A SINGLE JET EXHAUST
Charles E. Brazzel and James H. Henderson *In* AGARD The Fluid Dyn. Aspects of Ballistics 1966 p 241–261 refs (See N67-15361 06-12) CFSTI: HC $3.00/MF $0.65

An empirical technique has been formulated for estimating the base drag of bodies-of-revolution with a central jet exhausting through the base. The technique is based on successful correlation of an extensive amount of experimental data covering a wide range of parametric variation. The basis of the correlation is an apparent relationship between the base pressure ratio and the ratio of momentum flux of the jet to the momentum flux of the equivalent body stream-tube. The elementary form of the derived expressions allows rapid estimates of power-on base drag using a desk calculator. Author

N67-15374# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Porz (West Germany).
EXPERIMENTAL INVESTIGATION ON THE EFFECT OF TAIL SURFACES AND ANGLE OF ATTACK ON BASE PRESSURE IN SUPERSONIC FLOW
A. Heyser, F. Maurer, and E. Oberdoerffer *In* AGARD The Fluid Dyn. Aspects of Ballistics 1966 p 263–290 refs (See N67-15361 06-12) CFSTI: HC $3.00/MF $0.65

The results of wind tunnel measurements on base pressure models with and without tail surfaces are described. The longitudinal position of typical tail surfaces with wedge or double-wedge profiles and different planforms was changed in order to see the influence on pressure distributions measured on the model base. Mean values of these distributions show strong and repeatable variations depending on the longitudinal position of the tail surfaces. Author

N67-15375# Naval Ordnance Lab., White Oak, Md.
WIND TUNNEL AND COMPUTER STUDIES OF A LOW DRAG BOMB WITH VARIOUS TAIL STABILIZERS
Frank J. Regan, John H. Shannon (Weapons Res. Estab.), and Frank J. Tanner (Roy. Aircraft Estab., Farnborough, England) *In* AGARD The Fluid Dyn. Aspects of Ballistics 1966 p 291–317 refs Prepared Jointly with RAE and Weapons Res. Estab. (See N67-15361 06-12) CFSTI: HC $3.00/MF $0.65

This paper describes the background and intent of a bomb stability program including the evolution of the basic research store. The scope of the instrumented bomb program is discussed, together with the available wind tunnel data. Finally a preliminary computer-free-flight comparison is made. Author

N67-15376# Naval Weapons Lab., Dahlgren, Va.
THE FLIGHT DYNAMICS OF A BOMB WITH A CRUCIFORM TAIL
W. R. Chadwick *In* AGARD The Fluid Dyn. Aspects of Ballistics 1966 p 310–339 refs (See N67-15361 06-12) CFSTI: HC $3.00/MF $0.65

A mathematical model has been used to determine the influence of a nonlinear yaw-induced roll moment and side moment on the dynamic stability of a bomb with cruciform tail. Two problem areas were studied, the first associated with roll yaw resonance and the second with catastrophic yaw. It is shown that problems in resonance stability may be considerably greater than those predicted by linear theory and that launch disturbances in a single plane in space may degenerate rapidly into circular catastrophic yaw. Author

N67-15377# Naval Ordnance Lab., White Oak, Md.
MAGNUS EFFECTS
Frank J. Regan *In* AGARD The Fluid Dyn. Aspects of Ballistics 1966 p 341–364 refs (See N67-15361 06-12) CFSTI: HC $3.00/MF $0.65

The purpose of this paper is to summarize the past attempts to measure the Magnus effect that have been reported in the open literature. Attention is primarily confined to work of the past ten years. These data are examined from the point of view of the type of facility (ballistic range, wind tunnel, free flight), Mach number range, Reynolds number, and type of shape (finned or non-finned). Theories are examined as to type of flow (potential or viscous), and if viscous effects are studied the type of boundary layer (compressible, laminar, turbulent) is examined. Author

N67-15378# Naval Ordnance Test Station, China Lake, Calif.
NON-LINEAR MAGNUS MOMENT
William R. Haseltine *In* AGARD The Fluid Dyn. Aspects of Ballistics 1966 p 365–374 (See N67-15361 06-12) CFSTI: HC $3.00/MF $0.65

At subsonic speeds some spin-stabilized projectiles and rockets experience Magnus moments which are nonlinear in yaw angle. The yaw camera and yaw sondes have proved to be powerful tools in the study of the stability of spinning projectiles. Simplified theory can account for rather odd behavior if nonlinear aerodynamics is considered. Some very simple projectiles exhibit Magnus moments which are drastically nonlinear at quite small yaw angles and hence have limit cycles in yaw, flying with a steady, nonzero, oscillatory yaw in addition to their yaw of repose. Author

N67-15380# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
OBTAINING ACCURATE AERODYNAMIC FORCE AND MOMENT RESULTS FROM BALLISTIC TESTS
Gary T. Chapman and Donn B. Kirk *In* AGARD The Fluid Dyn. Aspects of Ballistics 1966 p 381–401 refs (See N67-15361 06-12) CFSTI: HC $3.00/MF $0.65

An examination is made of various sources of error that can affect aerodynamic parameters deduced from ballistic tests. A mathematical approach is made to determine the funtional dependence of the final results on the various random errors. A statistical treatment follows, employing a Monte Carlo technique to perturb exact trajectories, which verified the mathematical approach. Several assumptions of the mathematical model used in analyzing the data are then investigated. It is found that these assumptions can lead to large systematic errors in some deduced parameters, but that these errors can be reduced or eliminated by recognizing their cause. Facility calibration and model preparation features that are important to obtain accurate aerodynamic results are discussed. Finally, an approach to data analysis and its advantage over present systems is introduced. Author

N67-15384*# Rice Univ., Houston, Tex.
MAXIMUM LIFT-TO-DRAG RATIO OF A SLENDER, FLAT-TOP, HYPERSONIC BODY
Angelo Miele, David G. Hull, and Squire L. Brown 1967 26 p refs
(Grant NGR-44-006-045)
(NASA-CR-81157; AAR-30) CFSTI: HC $3.00/MF $0.65 CSCL 01A

The lift-drag ratio attainable by a slender, flat-top, homothetic body flying at hypersonic speeds was investigated under the assumptions that the pressure distribution is modified Newtonian and the surface-averaged skin-friction coefficient is constant. It is shown that a value of the thickness ratio exists such that the lift-drag ratio is a maximum; this particular value is such that the friction drag is one-third of the total drag. The subsequent optimization of the longitudinal and transversal contours is reduced to the extremization of products of powers of integrals related to the lift, the pressure drag, and the skin-friction drag. With regard to the longitudinal contour, a conical solution was found to be best. The optimal solution for the transversal contour was stated to be triangular without or with a vertical keel at midsection depending on whether the cross-sectional elongation ratio μ is smaller or larger than the critical value $\mu = 0.206$. The lift-drag ratio of the optimum body increases as the elongation ratio of the cross section decreases; for a Newtonian pressure distribution and a surface-averaged skin-friction coefficient $C_f = 10^{-3}$, the highest attainable lift-drag ratio is $E = 5.29$. Author

N67-15559*# National Aeronautics and Space Administration, Washington, D. C.

INVESTIGATION OF THE FLOW PAST ELLIPTICAL CONES [ISSLEDOVANIYE OBTEKANIYA ELLIPTICHESKIKH KONUSOV]

A. I. Shvets Dec. 1966 12 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Zhidkosti i Gaza (Moscow), no. 1, 1966 p 130–137

(NASA-TT-F-10480) CFSTI: HC $3.00/MF $0.65 CSCL 01A

A wind-tunnel investigation of the flow past six models of an elliptic cone at Mach numbers of 0.58, 0.97, 1.19, 1.47 and 3.0, and Reynolds numbers ranging from 1.2×10^6 to 3.0×10^6 is presented. The pressure distributions at the surface of the models and the quantities characterizing the flow parameters in the working section of the tunnel are plotted and discussed. For the small supersonic Mach numbers, it is found that the shock wave front for all the models employed has the form of an almost regular circular cone and that the local angle of a shock wave depends more on the distribution of the cross section along the axis of the body than on the shape of the body's cross section. With increasing Mach number, the shape of the shock wave in the cross section normal to the flow direction approaches that of the body. Author

N67-15664*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

EXPERIMENTAL INVESTIGATION OF SECONDARY JETS FROM TWO-DIMENSIONAL NOZZLES WITH VARIOUS EXIT MACH NUMBERS FOR HYPERSONIC CONTROL APPLICATION

James R. Sterrett, John B. Barber, Daisy W. Alston, and David J. Romeo Washington, NASA, Jan. 1967 48 p refs

(NASA-TN-D-3795) CFSTI: HC $3.00/MF $0.65 CSCL 01A

The effects of two-dimensional secondary jets issuing approximately perpendicular to a flat plate have been investigated at a free-stream Mach number of 6. The parameters varied were secondary jet exit Mach number (1 to 6), jet total pressure, and jet orifice width. Free-stream tunnel conditions and secondary jet total temperatures remained constant. The boundary layer on the plate in the vicinity of the jet was turbulent. In addition to jet shock structures, jet penetration, and separation distances, the gross aerodynamic normal forces as determined from pressure distributions were examined. The data for the conditions of this investigation show that the aerodynamic normal force for a given jet mass flow decreases with increasing jet exit Mach number but the total normal force (including reaction) is a constant for a given jet mass flow and independent of jet exit Mach number. Author

N67-15693*# National Aeronautics and Space Administration, Washington, D. C.

NUMERICAL SOLUTION OF THE PROBLEM OF SUPERSONIC FLOW AT AN ANGLE OF ATTACK PAST CONICAL BODIES [K CHISLENNOMU RESHENIYU ZADACHI O SVERKHZVUKOVOM OBTEKANII KONICHESKIKH TEL POD UGLOM ATAKI]

N. A. Makhin and V. F. Syagayev Dec. 1966 6 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. Hidkosti i Gaza (USSR), no. 1, 1966 p 140–142

(NASA-TT-F-10481) CFSTI: HC $3.00/MF $0.65 CSCL 01A

Discussed is an improvement to a method proposed by Syagayev for calculating the flow past an orbitrary smooth cone—e.g., an elliptical cone. The original method is associated with difficulties due to the unknown position of the critical point on a cone and the necessity of formulating additional singularities. Another drawback is the assumption that on a solid body the entropy function has its maximum value. It is shown that the potentialities of the method can be substantially increased by substituting Ξ, ϕ coordinates for the spherical coordinates ϕ, and to consider not the entropy function but rather density and pressure as the quantities to be determined. Author

N67-15694*# National Aeronautics and Space Administration, Washington, D. C.

SHAPES FORMED BY STREAM SURFACES OF CONICAL FLOWS [TELA, OBRAZOVANNYYE POVERKHNOSTYAMI TOKA KONICHESKIKH TECHENIY]

G. I. Maykapar Dec. 1966 5 p refs Transl. into ENGLISH from Izv. Akad. Nauk USSR, Mekhan. Zhidkosti i Gaza (USSR), no. 1, 1966 p 126–127

(NASA-TT-F-10484) CFSTI: HC $3.00/MF $0.65 CSCL 01A

Analyses show that stream surfaces of supersonic flows past cones at zero angle of attack can be used to construct a wide class of shapes for which the aerodynamic characteristics are easy to determine. The lines of intersection of the nose shocks form the edges of these shapes. As distinct from shapes obtained with the aid of current surfaces behind plane shocks, the cross sections of the shapes under consideration vary along their length. Author

N67-15699*# National Aeronautics and Space Administration, Washington, D. C.

HYPERSONIC PROFILE OF MINIMUM DRAG, HAVING AN ASSIGNED BENDING STRENGTH [GIPERZVUKOVOY PROFIL', IMEYUSHCHIY ZADANNUYU PROCHNOST NA IZGIB I MINIMAL'NOYE SOPROTIVLENIYE]

Ye. V. Bulygina and Yu. N. Yudintsev Jan. 1967 9 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Ser. Aviats. Tekh. (Kazan), no. 2, 1966 p 119–125

(NASA-TT-F-10639) CFSTI: HC $3.00/MF $0.65 CSCL 01A

The authors try to find the most advantageous form of a hypersonic profile which, for a given drag torque, has minimum drag. The problem is solved by a variational method. Author

N67-15832*# National Aeronautics and Space Administration, Washington, D. C.

AERODYNAMIC CHARACTERISTICS OF RECTANGULAR PLATES IN HYPERSONIC FLOW OF A RAREFIED GAS [AERODINAMICHESKIYE KHARAKTERISTIKI PRYAMOUGOL'NYKH PLASTIN V GIPERZVUKOVOM POTOKE RAZREZHENNOGO GAZA]

M. D. Ladyzhenskiy and A. V. Lipin Dec. 1966 6 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekhan. Zhidkosti i Gaza (USSR), no. 1, 1966 p 142–144

(NASA-TT-F-10483) CFSTI: HC $3.00/MF $0.65 CSCL 01A

Details are given on the experimental investigations of the aerodynamic characteristics of rectangular plates of equal area s, various aspect ratios λ and thickness d, at a Mach number of the unperturbed flow M=5.15, Reynolds number $R \approx 2 \cdot 10^2$, and angles of attack α varying from 0 to 40° for the purpose of determining the optimum shape of wings in a viscous hypersonic flow. The aspect ratio λ of the plates was varied in the range from 0.1 to 9 and their relative thickness $\delta = d/\sqrt{s}$ in the range from 0.25–0.16. Author

N67-15842*# National Aeronautics and Space Administration, Washington, D. C.

SOME EXACT SOLUTIONS OF THE PROBLEM OF THE HYPERSONIC OR SUPERSONIC FLOW OF A GAS PAST A SLIPPING WING WITH STALL FENCE [NEKOTORYYE TOCHNYYE RESHENIYA ZADACHI OBTEKANIYA SKOL' ZYASHCHEGO KRYLA S PEREGORODKOY SVERKHZVUKOVYM I GIPERZVUKOVYM POTOKOM GAZA]

A. I. Golubinskiy and A. N. Ivanov Dec. 1966 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Zhidkosti i Gaza (Moscow), no. 1, Jan.–Feb. 1966 p 145–149
(NASA-TT-F-10485) CFSTI: HC $3.00/MF $0.65 CSCL 01A

A class of three-dimensional configurations representing a combination of a slipping or delta wing and a stall fence mounted on the wing parallel to the oncoming flow was constructed. It is shown that for such configurations, exact solutions for hypersonic or supersonic flow can be obtained without recourse to the small perturbation method. A solution for the flow past two intersecting yawing wings is obtained as a special case. Flow analysis reveals strong interference at high speeds leading to much higher local pressures than in the case of an isolated wing. Author

N67-15848# Lockheed Missiles and Space Co., Palo Alto, Calif.

STABILITY OF AN ELASTIC BODY OF REVOLUTION SUBJECTED TO A FOLLOWING FORCE IN A GAS FLOW

A. G. Gorshkov and F. N. Shkliarchuk [1966] 6 p refs Transl. into ENGLISH from Mekh. Tverdogo Tel (Moscow), no. 5, 1966 p 151–154

A series of differential equations is derived to solve the problem of perturbed accelerated motion of a thin finned body of revolution in a gas flow subjected to a following force applied to its end. The motion is examined in an x–y velocity coordinate system, where the x axis is in the direction of the flow velocity vector and makes a small angle with the body axis. Only stability of the motion relative to the center of mass is examined. Two examples are given: a large-span body as an elastic beam and a constant section homogeneous beam with a pointed nose. L.E.W.

N67-15957*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

EFFECTS OF CONFIGURATION GEOMETRY ON THE SUPERSONIC AERODYNAMIC CHARACTERISTICS OF A SIMULATED LAUNCH VEHICLE

Richard D. Samuels and James A. Blackwell, Jr. Washington, NASA, Jan. 1967 35 p refs
(NASA-TN-D-3755) CFSTI: HC $3.00/MF $0.65 CSCL 01A

An investigation to determine the effects of nose-cone angle, upper-stage fineness ratio, and transition-flare angle on the aerodynamic force and moment characteristics of a simulated launch vehicle was conducted at Mach numbers from 1.60 to 2.86, angles of attack from −4° to 10°, and a Reynolds number of 2×10^6 per foot (6.56×10^6 per meter). The results indicate that increasing the nose-cone half-angle from 15.3° to 30° has no appreciable effect on normal-force, pitching-moment, or center-of-pressure characteristics. However, this increase in nose-cone angle roughly doubled the axial force. An increase in the upper-stage fineness ratio from 1.42 to 4.85 causes an increase in axial force along with an increase in pitching-moment coefficient and a forward movement of the center-of-pressure location. Increasing the transition-flare angle tends to increase the axial force while having no noticeable effect on the other aerodynamic force and moment characteristics. Author

N67-15958*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

HOVERING PERFORMANCE CHARACTERISTICS OF A ROTOR WITH AND WITHOUT BLADE-PITCH SERVO-CONTROL FLAPS

James P. Shivers Washington, NASA, Jan. 1967 17 p refs
(NASA-TN-D-3788) CFSTI: HC $3.00/MF $0.65 CSCL 01A

Results from previous research indicate that the profile losses can be doubled when the blade-tip angle of attack exceeds the angle for either stall or drag divergence by only a few degrees. Observations of tuft patterns for blades from previous tests indicate that initial section stall occurs at different spanwise locations for the blades depending on the blade geometry and twist. Photographic studies of the present test rotor were made to observe visually the tuft action on the upper surface of the rotor blades and also streamer action under the rotor disk. Torque and thrust were measured over a range of blade pitch angles. Calculations were made to compare the basic blade performance to that predicted by theory. Also, the efficiency of this rotor is compared with that for numerous other rotors tested. The rotor system was tested on the Langley Research Center helicopter tower at tip speeds of 558 and 628 feet per second (170.08 and 191.41 m/s) with corresponding tip Reynolds number of 5.99×10^6 and 6.73×10^6, respectively. The rotor was tested with and without servo flaps. Author

N67-16154# Hughes Tool Co., Culver City, Calif.

INVESTIGATION OF GENERALIZED METHODS FOR USE OF EXCITATION PANELS TO PRODUCE HELICOPTER ROTOR BLADE FLIGHT FATIGUE LOADS DURING WHIRL TEST Final Report, 14 Jan. 1965–14 Apr. 1966

J. D. Eakin and K. B. Amer Philadelphia, Pa., Naval Air Eng. Center, 16 Aug. 1966 50 p refs
(Contract N156-46217)
(NAEC-ASL-1100; HTC-AD-66-7; AD-641030) CFSTI: HC $3.00/MF $0.65

To supplement previous data obtained with three blades, rotors with two and four blades were whirl tested using the excitation panel technique. Rotor blades were tested having two different chord widths. A survey was made of the transient pressures produced on the excitation panels by the rotor blades. The resonant frequency of the third bending mode of the rotor blade was shifted from below the normal operating range to the maximum continuous power-on rpm by adding external weights to the blade leading edge. The use of a counterweight to replace a fatigue-damaged rotor blade during whirl testing was studied and rejected as being overly complicated. Author (TAB)

N67-16168*# Wichita Univ., Kans. Dept. of Aeronautical Engineering.

ON THE THEORY OF THE DELTA WING

Melvin H. Snyder, Jr., ed. Sep. 1966 59 p refs
(Grant NGR-17-003-003)
(NASA-CR-81254; AR-66-4) CSCL 01A

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3. ON THE BURSTING OF THE APEX-VORTICES OF A DELTA WING AT LOW SPEEDS H. Werle p 41–53 refs (See N67-16170 06-01)

N67-16169*# Wichita Univ., Kans. Dept. of Aeronautical Engineering.

VORTICES FROM THE APEX AND SHEETS IN CORNET [TOURBILLONS D'APEX ET NAPPES EN CORNET]

Maurice Roy *In its* On the Theory of the Delta Wing Sep. 1966 p 11–40 Transl. into ENGLISH from Rech. Aeron. (Chatillon-sous-Bagneux), no. 56, Feb. 1957 (See N67-16168 06-01)

The flow of air around delta and other sweptback wings is treated, and research on the visualization of these flows is reported. The vortex sheets which separate from the sharp leading edge of a thin delta wing are described, and the flow field around a thin, flat delta wing with sharp leading edges operating at a positive angle of attack is analyzed. L.E.W.

N67-16170*# Wichita Univ., Kans. Dept. of Aeronautical Engineering.

ON THE BURSTING OF THE APEX-VORTICES OF A DELTA WING AT LOW SPEEDS [SUR L'ECLATEMENT DES TOURBILLONS D'APEX D'UNE AILE DELTA AUX FAIBLES VITESSES]

H. Werle *In its* On the Theory of the Delta Wing Sep. 1966 p 41–53 refs Transl. into ENGLISH from Rech. Aeron. (Chatillon-sous-Bagneux, no. 74, Jan.–Feb. 1960 (See N67-16168 06-01)

A study was made of the bursting or explosion of the conical vortex sheet above the delta wing surface. Descriptions are given of investigations carried out in a hydrodynamic tunnel which permitted a determination of the mechanism of the explosion, the influence of the downstream conditions, and the principal parameters. L.E.W.

N67-16182# Naval Ordnance Lab., White Oak, Md.

DRAG AND STABILITY DATA OBTAINED FROM FREE-FLIGHT HYPERSONIC FIRINGS OF BOTH SHARP AND BLUNT NOSED 12-DEGREE 40-MINUTE TOTAL-ANGLE CONES AT SEVERAL RANGE PRESSURES

Leonard E. Crogan 11 Jul. 1966 22 p ref
(NOLTR-63-36; Ballistics Res. Rept.-94; AD-641137) CFSTI: HC $3.00/MF $0.65

Drag and stability data obtained from hypersonic firings of both pointed and blunt nosed 12-degree 40-minute total-angle cones at several range pressures are tabulated. The drag coefficient of both cones decreased with an increase in the Reynolds number. No effect of Reynolds number on the center of pressure of either cone configuration was observed. Author (TAB)

N67-16186# David Taylor Model Basin, Washington, D. C.

THE INVERSE PROBLEM OF THE ANNULAR AIRFOIL AND DUCTED PROPELLER Final Report

William B. Morgan and Robert G. Voigt Sep. 1966 59 p refs
(DTMB-2251; AD-641337) CFSTI: HC $3.00/MF $0.65

A computer program is presented that calculates the annular airfoil shape from a given pressure distribution. A brief review of the theory of the inverse problem of the annular airfoil is also presented. The distortion of the duct shape by the presence of an axisymmetric body or a propeller may be taken into consideration. shape. Author (TAB)

N67-16194# National Physical Lab., Teddington (England). Aerodynamics Div.

ON CERTAIN TYPES OF SELF-EXCITED OSCILLATION OCCURRING WITH AIRCRAFT CONTROL SURFACES IN TRANSONIC FLOW

N. C. Lambourne 21 Feb. 1966 15 p refs Presented at the Colloq. on Mech. Vibration and Shock, London, 30 Mar. 1966
(NPL-AERO-1191; ARC-27852; AD-642156) CFSTI: HC $3.00/MF $0.65

Brief reference is made to the results of wind-tunnel experiments on self-excited oscillations of control surfaces in transonic flow. Two particular examples are discussed and an attempt is made to provide theoretical mechanisms of oscillation which are in agreement with the observations. Author (TAB)

N67-16199# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.

MACHINE COMPUTATION OF AERODYNAMIC LOADS IN LINEAR SITUATIONS

Holt Ashley Jul. 1966 32 p refs
(Contract AF 49(638)-1622)
(AFOSR-66-1440; Rept.-66-5; AD-641202) CFSTI: HC $3.00/MF $0.65

The paper reviews recent successful efforts to determine the near field, i.e., to find the pressure distribution experienced by such surfaces. These involve a complete linearization of the governing differential equations and boundary conditions. With the object of escaping from the linear constraint -- often a very restrictive one -- recipes are given for higher-order calculations in two important situations. For inviscid, constant-density fluid flow, where the differential equation is linear, source and vortex methods have already been published whereby certain cases with nonlinear boundary conditions can be effectively analyzed. A new procedure is described which will permit the analysis of general three-dimensional wings, with circulation and a specified trailing-edge flow-off condition, by means of potential doublet sheets. It constructs the flow by computing transient fluid response from an undisturbed initial condition and is therefore specially adapted to unsteady-flow problems. The second case discussed involves certain second-order effects on loading in rectilinear supersonic flight, again allowing for unsteady effects of simple harmonic motion. It is shown how the linear solution for a source sheet can be modified to account for coupling with the steady flow due to thickness. Velocity potential sources are distributed over many small rectangular area elements and their loading contributions superimposed in the manner of aerodynamic influence coefficients. Author (TAB)

N67-16205# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF THE LAMINAR BOUNDARY LAYER IN THE FLOW PAST A THIN BLUNTED CONE AT HIGH SUPERSONIC VELOCITIES

I. N. Murzinov 18 Apr. 1966 9 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 1, 1961 p 152–153
(FTD-TT-65-1118; TT-66-62500; AD-640728) CFSTI: HC $3.00/MF $0.65

In the flight of thin blunted bodies in the atmosphere at great altitudes, an influence on the distribution of the pressure over the generatrices is exerted by the blunting and also by the thickened boundary layer. This influence is examined by the method of small disturbances with high flight Mach numbers. TAB

N67-16213# Aeronautical Research Council (Gt. Brit.)

FURTHER TESTS WITH A VARIABLE RAMP INTAKE HAVING A DESIGN MACH NUMBER OF 2.2

M. C. Neale and P. S. Lamb London, HMSO, 1966 20 p ref Supersedes NGTE-NT-506; ARC-24599
(ARC-CP-826; NGTE-NT-506; ARC-24599; AD-800212) CFSTI: HC $3.00/MF $0.65

Results are reported of tests on a two-dimensional combined external/internal compression intake having a design Mach number of 2.2. The particular parameters investigated in the tests now reported are: the design of the boundary layer bleed slot; the terminal supersonic Mach number; and the free stream Reynolds number. The maximum pressure recovery obtained at the design Mach number was 88-1/2% with 3% bleed at a Reynolds number, based on free stream conditions and intake capture height, of 3.25×10^6 Author (TAB)

N67-16465# Stevens Inst. of Tech., Hoboken, N. J. Davidson Lab.
HYDROFOIL FLUTTER PHENOMENON AND AIRFOIL FLUTTER THEORY. VOLUME IV: FINITE ASPECT RATIO
Charles J. Henry and M. Raihan Ali Oct. 1966 52 p refs
(Contract NObs-88365)
(R-1170; AD-642746) CFSTI: HC $3.00/MF $0.65

Measured decay rates and flutter speeds for two-degree-of-freedom hydrofoil models with finite aspect ratio are compared with those predicted by two-dimensional airfoil theory applied in a stripwise manner. The flutter speed of one of the experimental configurations is also predicted by means of three-dimensional lifting-surface theory. Both theory and experiment indicate that flutter speed increases as aspect ratio is decreased. However, the non-conservative discrepancy found previously between measured and predicted two-degree-of-freedom flutter speeds in two-dimensional flow persists in these three-dimensional results. Author (TAB)

N67-16601# Aeronautical Research Council (Gt. Brit.)
FORCE AND MOMENT MEASUREMENTS ON THREE DELTA WINGS OF ASPECT RATIOS 0.83, 1.03 AND 1.24 IN COMBINATION WITH BODIES OF FINENESS RATIO 13 AT A MACH NUMBER OF 4 Aerodynamic Study
D. R. Andrews Apr. 1962 34 p refs Supersedes RAE-TN-AERO-2816, ARC-24048
(ARC-CP-888; RAE-TN-AERO-2816; ARC-24048) CFSTI: HC $3.00/MF $0.65

Force measurements have been made in the high supersonic speed wind tunnel on a series of wing-body configurations at a Mach number of 4 and Reynolds number of 32×10^6. The combinations tested consisted of circular section bodies of fineness ratio 13 and delta wings of aspect ratios 0.83, 1.03 and 1.24. The wing span of all combinations was 5 body diameters. Lift and pitching moment variations with incidence were found to be reasonably linear up to 20°, which was the limit of the present tests. The highest lift drag ratio was obtained with the lowest aspect ratio wing, giving a figure of 5.7 for a 3 caliber ogival nose on the body and 6.2 for a 5 caliber nose. It was found that the force and moment characteristics could in general be predicted adequately from existing theories, the main exception being the rolling moment due to sideslip. Author

N67-16645# North American Aviation, Inc., Los Angeles, Calif.
HYPERSONIC FLOW OVER LIFTING WING BODY COMBINATIONS
N. D. Malmuth 1 Jun. 1966 17 p refs
(Contract AF 49(638)-1477)
(AFOSR-66-1398; NA-66-431; AD-640278) CFSTI: HC $3.00/MF $0.65

Using linear rotational flow methods within the framework of Hypersonic Small Disturbance Theory, the flow over a class of lifting wing-body combinations is analyzed. These configurations consist of a delta wing mounted on top of a slender ruled body of arbitrary cross section, contained within the parabolic Mach cone. Solutions for the shock shape, lift and the pressure field between the body and shock are obtained using eigenfunction techniques developed in connection with other wedge-like flows. Recommendations are made for future extensions of the analysis involving the determination of optimum contouring as well as treatment of more general classes of bodies. Author (TAB)

N67-16675*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
FLUTTER ANALYSIS OF FLAT RECTANGULAR PANELS BASED ON THREE-DIMENSIONAL SUPERSONIC UNSTEADY POTENTIAL FLOW
Herbert J. Cunningham Washington, NASA, Feb. 1967 52 p refs
(NASA-TR-R-256) CFSTI: HC $3.00/MF $0.65 CSCL 01A

A systematic analytical procedure has been developed for computing flutter characteristics of rectangular panels with stream-alined side edges, based on air forces from three-dimensional linearized supersonic unsteady potential flow. The procedure has particular usefulness in the low supersonic speed range. The panel is considered to be finely divided into many boxes, and the aerodynamic influence coefficients between all pairs of boxes are obtained by numerical integration. The flutter analysis is a modal type, which readily coordinates with the aerodynamic box method, and can be used for calculating the flutter stability of any flat or nearly flat panel, whether of isotropic or anisotropic stiffness, and of buckled panels for which the flutter is a small-amplitude, simple harmonic, superimposed motion to which linear theory is applicable. Results are presented for flat unstressed, isotropic panels with simply supported edges and with clamped edges. For clamped-edge aluminum panels with a length–width ratio of 2 at sea level, the panel flutter parameters are tabulated for eight Mach numbers ranging from 1.02 to 2.0. For Mach 1.3, flutter boundaries are plotted for length–width ratios from 0 to 10 for simply supported edges and from 0 to 4 for clamped edges so that design values can be read for wide range of panel materials and air densities. Author

N67-16682* Bell Aerosystems Co., Buffalo, N. Y.
ANALYTICAL AND EXPERIMENTAL STUDIES OF SOUND PRESSURES ON DUCTED PROPELLERS Final Report
W. Fricke, J. R. Bissell, W. T. Bamberg, and C. K. Mart Dec. 1966 75 p refs
(Contract NASw-1217)
(NASA-CR-66270; Rept.-9500-950001) CFSTI: HC $3.00/MF $0.65 CSCL 01A

An analytical approach for the prediction of rotational sound due to blade loadings in the duct of ducted propellers has been developed, based on definable propulsion quantities. Tests were conducted on a full-scale model of a 3-blade, ducted propeller. A comparison of the experimental data with those analytically predicted showed the following results: The calculated and measured overall sound pressure levels at the propeller plane and along the inner wall of the duct are in good agreement, with some deviations not exceeding 2db. Therefore, the analytical approach is a satisfactory tool for predicting the overall sound pressure distribution along the duct wall. A comparison of the calculated and measured sound pressures of the higher harmonics shows different decays. This may be attributed to the rectangular blade pressure distribution, radial and chordwise, assumed in the analysis. The radial decay of the measured and calculated sound pressure behind the propeller plane is similar in the region near the duct wall, but differs when approaching the hub surface. This effect may be explained by a turbulent wake found to exist in this region by a flow velocity survey. An additional experimental study was conducted on the effect of increased tip clearance on sound pressure. Author

N67-16691*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CORRELATION OF FREE-FLIGHT TURBULENT HEAT-TRANSFER DATA FROM AXISYMMETRIC BODIES WITH COMPRESSIBLE FLAT-PLATE RELATIONSHIPS
Ernest V. Zoby and Edward M. Sullivan Washington, NASA, Jan. 1967 22 p refs
(NASA-TN-D-3802) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Published experimental turbulent heat-transfer data obtained over a range of free-flight conditions and body shapes were compared with calculated turbulent flat-plate values. The calculated values were evaluated by use of a modified Reynolds analogy and the skin-friction relationships of Blasius or Schultz–Grunow with compressibility effects accounted for by evaluating the flow properties on reference conditions. For reference Reynolds numbers less than 10^7, the calculated heating rates based on either of the two methods correlated well with the experimental data. For reference Reynolds numbers greater than 10^7 and less than 8×10^7, the calculated heating rates based on the Schultz–Grunow relation compare better with the available experimental data. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N67-15459# Defence Research Board, Ottawa (Ontario).
TRIALS OF AN SR.N5 HOVERCRAFT IN NORTHERN CANADA, SPRING 1966
Oct. 1966 109 p refs Prepared Jointly with Interservice Hovercraft Trails Unit, Natl. Aeron. Estab., and Northern Co-ordination and Res. Centre
(DR-182) CFSTI: HC $3.00/MF $0.65

An SR. N5 hovercraft was operated for 71 hours during the period 22 April to 30 May, 1966, in Canada's Northwest Territories. This period covered temperatures ranging between −24°F (−31°C), and 60°F (16°C). The hovercraft was tested over a variety of surfaces: the fast ice of Kugmallit Bay, pressure ridges, typical first-year sea ice, and overland. A 500-mile trip from Tuktoyaktuk on the Arctic coast to Norman Wells was also accomplished. On this last, the hovercraft traveled through all the phases of break-up on the Mackenzie River. With the exception of the severest river breakup conditions, few problems were experienced. The maintenance and serviceability of the vehicle also presented little difficulty. In general, this hovercraft could negotiate all surface conditions encountered in these trials. Author

N67-15778# Federal Aviation Agency, Washington, D. C. Aircraft Development Service.
EMERGENCY EVACUATION TESTS OF A CRASHED L-1649
J. D. Garner and John G. Blethrow Sep. 1966 53 p
(FAA-ADS-49)

Four basic evacuation tests were performed on a crashed L-1649 to document problem areas, passenger reaction, emergency lighting, slope of flooring and other items affecting passenger egress. Two day and two night tests were run with different crew and passengers for each. The tests were designed to observe the reactions of the crews and passengers under different emergency conditions rather than to compare the results of one test with another. Data were collected by tape recordings, motion picture film, and questionnaires. Observations were recorded. The results are presented in this report. Author

N67-15968# Ryan Aeronautical Co., San Diego, Calif.
FLEXIBLE WING LIGHT UTILITY GLIDER Final Report, 23 Jul.–17 Sep. 1964
N. Sakamoto and G. Cota Ft. Eustis, Va., Army Aviation Mater. Labs., Aug. 1966 118 p refs
(Contract DA-44-177;AMC-209(T); ARPA Order 294)
(USAAVLABS-TR-66-2; Rept.-643139; AD-640987) CFSTI: HC $3.00/MF $0.65

Presented in the report are the results of a flight test program of a towed light utility glider system. The system was designed to carry odd-geometry cargo, and demonstrated towed flight operations up to the maximum design weight of 1500 pounds, at a velocity range extending from 30 to 70 knots indicated airspeed. Testing also included takeoff and landings on tow with helicopters, and evaluation of the flight homing system. Free flights of the light utility glider were also made carrying a payload of 800 pounds. Presented also are the system description, and an aerodynamic and structural analysis. Author (TAB)

N67-16181# General Dynamics Corp., Groton, Conn. Electric Boat Div.
THE DEVELOPMENT AND TESTING OF A CONTROL DECOUPLER FOR AIR CUSHION VEHICLES Final Report
Richard A. Miller and Frank J. Hannigan Oct. 1966 98 p refs
(Contract NObs-92050)
(U411-66-061; AD-642765) CFSTI: HC $3.00/MF $0.65

For an air cushion vehicle with rudders located well behind the center of gravity, a decoupler eliminates the yaw moment created by the rudders so that the rudder force can be used to control side motion. The necessary countermoment is provided by the differential thrust of two propellers located behind the center of gravity. A theoretical study including wind tunnel tests and extensive analog computer studies indicated that a direct measurement of the rudder side-force using load cells is the best approach. The load cells necessary for the side force detection were designed, constructed, and installed, and were used for data acquisition. Following this data acquisition, the decoupler computer was designed and the total decoupler was tested on Electric Boat divisions two-ton ACV, SKIP-1. The results indicate that the effect of the rudder side-force on the vehicles turning moment can be eliminated as intended. Author (TAB)

N67-16200# General Electric Co., Cincinnati, Ohio. Advanced Engine and Technology Dept.
STRUCTURAL PROOF TEST PROGRAM
[1966] 77 p refs
(Contract DA-44-177-TC-715)
(Rept.-126; AD-640340) CFSTI: HC $3.00/MF $0.65

The test program is designed to demonstrate integrity of aircraft structure and the information presented will be used to establish detail test procedures. The particular flight and landing load conditions to be simulated during test have been derived from structural analysis using the conditions specified in the Airplane Structural Design Criteria and have been found critical. A detailed listing of all test data requirements is given. The particular loads and reactions to be applied to the airframe and the major components are also given. Along with the strength tests, some additional control system tests are to be performed and are also described. Author (TAB)

N67-16343# Little (Arthur D.), Inc., Cambridge, Mass.
THE MEASUREMENT OF HIGH ALTITUDE BALLOON GAS TEMPERATURE
Robert M. Lucas and George H. Hall Oct. 1966 31 p refs
(Contract Nonr-3164(00))
(C-62944; TR-5; AD-641332) CFSTI: HC $3.00/MF $0.65

A mathematical model of the vertical motion of high altitude zero pressure balloons, programmed for a digital computer, has been in operation for several years. Correlation of input and output data of the program with the measured data of actual flights has been good, but incomplete, because of the lack of simultaneous measurements of balloon gas and air temperature. A test flight was conducted to obtain balloon gas and air temperatures. The necessary flight parameters were then used to fly the mathematical model and the output of this digital program, altitude, and gas temperature, were compared to the measured values. The resulting correlation indicate that the mathematical model is sufficiently accurate to predict the vertical motion of high altitude balloons providing the local air temperature profile is known. A preliminary test program was conducted to evaluate the thermistor characteristics, to provide the necessary calibrations, and determine the possible measuring errors. Author (TAB)

N67-16461# Bell Helicopter Co., Fort Worth, Tex.
FLIGHT EVALUATION OF THE CONTACT ANALOG PICTORIAL DISPLAY SYSTEM
J. G. Curtin, J. H. Emery, C. B. Elam, and D. J. Dougherty Feb. 1966 162 p
(Contracts Nonr-4429(00); Nonr-1670(00))
(D228-420-009; AD-640597) CFSTI: HC $3.00/MF $0.65

The work represents a series of flight test evaluations of a vertical flight display or contact analog. Three experimental flight tests were conducted in the JANAIR flight test vehicle which was a UH-1 helicopter known as Research Helicopter Number 2 (RH-2). The first study evaluated the vertical display containing the basic grid plane plus a ground position indicator. The hover flight mode was the test maneuver. Four types of control stabilization were tested with the display with varying degrees of control sensitivity. The second study examined the basic grid plane with and without a director symbol in the form of a glight pathway. Speed indices were presented on the pathway in the form of tarstrips and speed markers. During cross-country flight maneuvering, a ground position indicator defined final touch-down position. Only one flight stabilization mode was tested. The flights were comprehensive in their coverage of the spectrum of basic flight maneuvers. The final investigation was designed to determine the usefulness of augmenting the display components (horizon line and basic grid plane) with a TV presentation superimposed upon the vertical flight display. Several flight modes were investigated. Author (TAB)

N67-16593# Princeton Univ., N. J.
AN ANALYTICAL STUDY OF FACTORS INFLUENCING THE LONGITUDINAL STABILITY OF TILT-WING VTOL AIRCRAFT
G. Beppu and H. C. Curtiss, Jr. Ft. Eustis, Va., Army Aviation Materiel Labs., Jul. 1966 105 p refs
(Contract DA-44-177-AMC-8(T))
(USAAVLABS-TR-66-53; Rept.-756; AD-640945) CFSTI: HC $3.00/MF $0.65

An analytical method for predicting the stability characteristics of tilt-wing VTOL aircraft in the transition speed range is presented. Sample calculations based on an assumed tilt-wing VTOL transport configuration of the XC-142A class with double slotted flaps are given. Particular emphasis is placed on the sensitivity of the results to various assumptions made in the analysis. The contributions of the various aircraft components and the aerodynamic interactions of the components to the stability derivatives are discussed, as well as the changes in the characteristic modes of motion of the vehicle that result from variations in the stability derivatives. The trim conditions of the vehicle are shown to be quite sensitive to the prediction of the flap characteristics. A limited comparison of the calculated results with experimental data obtained from a dynamic model of the XC-142A, which is somewhat dissimilar from the assumed configuration, is presented. This comparison indicates that the trends of the stability derivatives are correctly predicted. The agreement between theory and experiment is good in hovering; however, as the wing incidence is reduced, the difference between theory and experiment becomes quite large. Author (TAB)

N67-16684*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WIND-TUNNEL INVESTIGATION OF THE FLIGHT CHARACTERISTICS OF A MODEL OF AN ASPECT-RATIO-6 CONICAL-PARAWING UTILITY VEHICLE
Charles C. Smith, Jr. and George M. Ware Washington, NASA, Feb. 1967 42 p refs
(NASA-TN-D-3673) CFSTI: HC $3.00/MF $0.35 CSCL 01C

A low-speed wind-tunnel investigation has been made to determine the flight characteristics of a flying model of a parawing vehicle with a wing having an aspect ratio of 6. Flight tests were made over an angle-of-attack range of the parawing keel from about 23° to 40°. The model consisted basically of a cargo platform attached to a parawing by means of an overhead truss arrangement, and it was powered by a pusher propeller located at the rear of the platform. Control was provided by pitching and rolling the wing and by a rudder surface mounted in the propeller slipstream. The results of the investigation showed that the model had satisfactory dynamic longitudinal and lateral stability, and the motions were well damped over the angle-of-attack range of the tests. The center-of-gravity-shift control system was reasonably effective for controlling the model but was considered relatively weak and was generally rated low in terms of conventional airplane control power requirements. Because of the good stability, however, this relatively weak control was generally satisfactory for maintaining wing-level flight and for performing the mild maneuvers possible in the tunnel. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N67-15419# Research Triangle Inst., Durham, N. C.
DISTRIBUTION OF THE FIRING ENERGY FOR THE SQUIB MK1 MOD 0
D. W. Gaylor and J. A. Merrill Sep. 1966 29 p refs
(Contract N178-8730)
(SU-238/1; AD-642095) CFSTI: HC $3.00/MF $0.65

Neither the log-normal nor the log-logistic provides an adequate fit over the entire range of the Squib Mk 1 Mod 0 data. Using unbiased estimates of firing probabilities, both of these distributions fit the lower 95% of the firing sensitivity data reasonably well. The log-normal gives a slightly better fit to these data. It is illustrated that the upper 5% of the firing energies generally contribute a negligible amount to the probability of an accidental firing. These data indicate that the log-normal distribution provides a satisfactory approximation when calculating the probability of an accidental firing. Since both the log-normal and log-logistic fit the Squib Mk

1 Mod 0 firing data about equally well, use of the log-normal distribution is recommended in HERO computations where the distribution of the induced currents also must be considered since this leads to a simpler procedure for estimating accidental firing probabilities. Author (TAB)

N67-15558*# National Aeronautics and Space Administration, Washington, D. C.
A STUDY OF THE RADIAL-AXIAL-FLOW TURBINE WITH LOW BLADE HEIGHTS AND LARGE CLEARANCES [ISSLEDOVANIYE RADIAL'NO-OSEVOY TURBINY S MALYMI VYSOTAMI LOPATOK I S BOL'SHIMI ZAZORAMI]
L. N. Odivanov and A. P. Tunakov Dec. 1966 15 p refs Transl. into ENGLISH from Aviatsionnaya Tekhnika (USSR), no. 1, 1964 p 133–144
(NASA-TT-F-10441) CFSTI: HC $3.00/MF $0.65 CSCL 13I

The radial-axial-flow turbine with blades of varying heights is tested. It is found that efficiency rises up to a certain blade height ($l_1 = 0.075$) and efficiency decreases slightly with a further increase in blade height. Author

N67-15691*# National Aeronautics and Space Administration, Washington, D. C.
EFFECT OF THE CLEARANCES BETWEEN THE CASTING AND THE WHEEL UPON THE EFFICIENCY OF THE CENTRIPETAL GAS TURBINE
A. Ye. Zaryankin and M. F. Zatsepin Dec. 1966 12 p refs Transl. into ENGLISH from Energomashinostr. (Moscow), no. 3, 1964 p 33–35
(NASA-TT-F-10450) CFSTI: HC $3.00/MF $0.65 CSCL 10A

It is assumed that in the general case, with all other conditions being equal, the turbine efficiency will be determined by the magnitude of the clearances at the input to the wheel Δ_1 and at the output from it Δ_2. Data and formulas are presented which make it possible to determine the influence of the clearances on the efficiency of a centripetal turbine for any values. The formulas are also applicable for axial and centrifugal compressors. K.W.

N67-15704*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
POWER SYSTEM CONFIGURATION STUDY
E. C. Jazwa *In its* Space Programs Sum. No. 37-41, Vol. IV 31 Oct. 1966 p 17–18 (N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

Optimum power system configurations for planetary spacecraft probes operating at 0.3 and 5.2 AU Sun-probe distances and Mars, Jupiter, and Venus orbiters were determined. Problems associated with implementing electrical power systems for these spacecraft and their missions were evaluated in an effort to provide overall system operation through the use of redundancy, failure detection, and the development of optimum monitoring techniques. Seven spacecraft configurations were generated to perform five basic missions and typical load equipment and input power characteristics were defined. Solar array current-voltage values were computed for each mission by comparing power capability as a function of mission time with modal spacecraft load profiles. G.G.

N67-15705*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena
STERILIZABLE BATTERY
R. Lutwack *In its* Space Programs Sum. No. 37-41, Vol. IV 31 Oct. 1966 p 18–19 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

Development of separators for sterilizable Ag–Zn batteries centered on the production of poly-2,2'-(hexamethylene)-5,5'-bis (1-β-cyanoethyl) benzimidazole films, ligand-containing polymers, composite membranes composed of an organic matrix and an inorganic phase, and layered separator material. Membranes with resistivity and diffusion values comparable to cellophane were obtained by filling organic substances with $Zr(OH)_4$, MgO, CaO, and ThO_2. Sealed Ag–Zn and Ag–Cd cells encased in polyphenylene oxide and polysulfone exhibited good sterilization properties when cases were carefully molded. G.G.

N67-15706*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PROPULSIVE LANDER CONTROL SYSTEM
R. J. Mankovitz *In its* Space Programs Sum. No. 37-41, Vol. IV 31 Oct. 1966 p 20–27 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

Described is the nominal control system designed to set down a propulsive lander with a vertical velocity of less than 25 ft/sec, a horizontal velocity of less than 5 ft/sec, and an attitude within 10 degree of local vertical. Ignition is started by a 20,000 ft. slant range mark from the radar system; the control system is in a stabilization mode for the initial 2 sec after ignition and thus counteracts thrust offset and aerodynamic torques. At completion of the stabilization mode, the gravity turn is initiated at 12.6 to 13 seconds, at which time the roll axis is aligned to the inertial path angle and terminal mode is started. Terminal modes consist either of a constant velocity descent at about 5 ft/sec, or of a constant acceleration level, less than one martian g, with a constant velocity loop identical to the stabilization mode. The latter mode shuts engines down at 10 ft, and the craft free-falls to the surface. G.G.

N67-15728*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LIQUID MAGNETOHYDRODYNAMIC (MHD) POWER CONVERSION
D. Elliott, D. Cerini, and L. Hays *In its* Space Programs Sum. No. 37-41, Vol. IV 31 Oct. 1966 p 124–132 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

The cycle of a liquid lithium magnetohydrodynamic generator is described. The results of tests to determine the compatibility of insulators and candidate separator materials with lithium at 2000°F are tabulated and discussed. The operating characteristics of a NaK–N_2 magnetohydrodynamic conversion system, which is being developed to verify present performance calculations based on component tests and to serve as a prototype of a subsequent high temperature system, are described. R.N.A.

N67-15729*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AN ADDITION TO THE RADIATOR SYSTEM COMPUTER PROGRAM
J. J. Volkoff *In its* Space Programs Sum. No. 37-41, Vol. IV 31 Oct. 1966 p 132–133 refs (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

The weight of an all-liquid, heat-rejection radiator system with coolant is evaluated in relation to spacecraft design, and the computer program changed to include the computation for coolant weight. The program now designates the fluid velocity in the header as a fraction of the fluid velocity in the tube. This fraction is selected to ensure a nearly uniform flow distribution throughout the tubular array in the panel system. Also included in the program are the computation of the mean tube temperature, and the weights of the coolant in the tubular array, supply header, and return headers. The resulting weight of the coolant required in the radiator sections is also read out as an output of the program. It is concluded that the weight of the liquid coolant is significant and must be considered in the design of a radiator system if a minimum-weight system is to be obtained. R.U.

N67-15782*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THERMIONIC CONVERTER AND GENERATOR DEVELOPMENT

P. Rouklove *In its* Space Programs Sum. No. 37-40, Vol. 4 31 Aug. 1966 p 1–14 refs (See N67-15781 06-34) CFSTI: HC $3.00/MF $0.65

Details are given on the evaluation of a four-converter thermionic generator which was developed as part of the solar energy thermionic (SET) program. Test equipment consisted of an electron bombardment heating power control cabinet; a vacuum system containing the generator under test and exhausted to the 10^{-8} torr range with a 600 liter/sec ion pump; a generator operating control and visual monitoring cabinet; and a 100 channel automatic data recording and printing system. Tests were performed at four different values of heat input: 900, 1000, 1100, and 1200 watts. Performance data are tabulated and graphically displayed. Also presented are the results of efforts to demonstrate automatic cesium reservoir temperature control. Two approaches were used: (1) an active control consisting of a thermal sensor, an electronic network, and a reservoir heater; and (2) a passive control composed of vane-type radiation shields mechanically actuated to control the thermal energy radiated from the reservoir surface. The active control system operated successfully; the results of the passive control device were considered disappointing. M.G.J.

N67-15798*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LIQUID MHD POWER CONVERSION
D. G. Elliott, D. J. Cerini, and L. G. Hays *In its* Space Programs Sum. No. 37-40, Vol. 4 31 Aug. 1966 p 63–72 ref (See N67-15781 06-34) CFSTI: HC $3.00/MF $0.65

A brief description is presented on the operating principles of the liquid metal magnetohydrodynamic (MHD) system, in which a fluid, such as cesium, circulates in the vapor loop and causes a liquid metal, such as lithium, to circulate through an MHD generator in the liquid loop. Summary information is also given on the procedures and results of tests conducted on a compensated ac MHD generator with successful conversion of NaK pressure drop energy to net ac electric power output on a self-excited basis. Both empty channel tests and flow tests were performed. A 2000°F lithium erosion test of 100-hour duration was also completed, during which the performance of high temperature loop components was determined. Maximum lithium velocity in the flow nozzles varied from 180 to 270 ft/sec. Preliminary evaluation indicates that the erosion test did not negate the use of Cb-1%Zr as a containment or separator material for high velocity lithium in the liquid MHD system. M.G.J.

N67-15940*# National Aeronautics and Space Administration, Washington, D. C.
ON FRICTION AND LEAKAGE LOSSES IN THE WORKING BLADE-RINGS OF RADIAL-FLOW TURBINES IN HELICOPTER AND TRANSPORT GAS-TURBINE UNITS [O POTERYAKH TRENIYA I VENTILYATSII V RABOCHIKH VENTSAKH RADIAL'NYKH TURBIN VERTOLETNYKH I TRANSPORTNYKH GTU]
N. F. Galitskiy Jan. 1967 12 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Aviats. Tekh. (Kazan), v. 7, no. 4, 1964 p 60–66
(NASA-TT-F-447) CFSTI: HC $3.00/MF $0.65 CSCL 10A

A working blade-ring containing 208 blades from a Ljungström turbine was rotated in the forward and reverse direction with variable rpm under the following conditions: in free space with coupled turbine guide blade-rings and in the annular space between the free floating rings and the guide blade-rings. The experimental installation is described in detail. Author

N67-15966# Naval Ordnance Lab., Corona, Calif.
CHEMOELECTRIC ENERGY CONVERSION FOR NONAQUEOUS RESERVE BATTERIES Quarterly Report, Apr.–Jun. 1966
Richard E. Panzer, Gerald E. McWilliams, and William S. Harris 15 Oct. 1966 17 p refs
(NOLC-689; QR-12; AD-642291) CFSTI: HC $3.00/MF $0.65

Studies were completed of reference electrodes for use in liquid ammonia solutions, and a soft glass-Pyrex separator with microcracks was adapted for use in reference electrodes for pressurized cells. Redox potentials and overvoltage relationships were determined for various cathector and matrix materials in liquid ammonia solutions, the shifts of potentials on the various metals and pyrolytic graphite providing an indication of their relative merit for hardware cell use. Initial study of the S-NH3 system was conducted in neutral solutions with a Pt screen as the cathode, a Pt anode, and a Pb wire reference electrode in a three-compartment cell. Reduction efficiency was twice as great in NaSCN than in NaI ammoniate. Qualitative tests of solubility enhancement indicated that addition of either ethylamine or ethylenediamine to liquid ammoniates increases the solubility of sulfur in neutral solutions. Author (TAB)

N67-15971# Bright Star Industries, Clifton, N. J.
ORGANIC DEPOLARIZED CELLS UTILIZING META-DINITROBENZENE Progress Report, 15 Sep. 1965–30 Jun. 1966
Sol S. Jaffe Ft. Monmouth, N. J., Army Electron. Command, Oct. 1966 94 p refs
(Contract DA-28-043-AMC-01401(E))
(ECOM-01401-2; QPR-2; Rept.-2; AD-641852) CFSTI: HC $3.00/MF $0.65

The fabrication of 'A' size cylindrical magnesium/magnesium perchlorate/m-dinitrobenzene cells was carried out within the framework of a fractional factorial experiment designed to explore and optimize several composition and design variables. The results indicate that cells giving an average of at least 26.8 hours of output (to 0.90 volt, through 16 2/3 ohms) can be built. TAB

N67-15976# Electric Storage Battery Co., Madison, Wis. Ray-O-Vac Div.
DEVELOPMENT OF MAGNESIUM FLAT CELL BATTERY Quarterly Report, 1 May–31 Jul. 1966
Philip F. Albert Ft. Monmouth, N. J., Army Electron. Command, Oct. 1966 21 p
(Contract DA-28-043-AMC-02136(E))
(ECOM-02136-1; Rept.-1; AD-640856) CFSTI: HC $3.00/MF $0.65

A literature search of magnesium cell technology was conducted to determine which formulations, ratios, and materials give maximum battery performance and minimum delayed action in the magnesium-manganese dioxide electrochemical system. Bench and oven testing was also carried out to determine the most suitable raw materials for the first series of batteries. Two lots of batteries, one lot using magnesium perchlorate electrolyte and one using magnesium bromide electrolyte, were assembled with each battery containing five flat cells using magnesium anodes. Initial performance figures on BA-399, continuous and intermittent drain discharge tests are given. Author (TAB)

N67-15977# Thermo Electron Engineering Corp., Waltham, Mass.
OPTIMUM ELECTRODE CAVITIES FOR THERMIONIC ENERGY CONVERTERS Final Report, 1 Aug. 1964–31 Jul. 1966
F. Rufeh, S. S. Kitrilakis, and D. Lieb Bedford, Mass., AFCRL, 31 Aug. 1966 89 p refs
(Contract AF 19(628)-4322)
(TE-15-67; AFCRL-66-683; AD-641432) CFSTI: HC $3.00/MF $0.65

The diffusion coefficient of cesium ions in cesium plasma and the reflection coefficient of the ions from the plasma boundaries

were measured using a three-collector thermionic diode. Based on these transport parameters, a cavity-collector diode was designed and constructed. The experimental data from this system indicates that the ions generated in the cavities diffuse to the surrounding regions and neutralize the electron space charge. This result is important to thermionic conversion since it shows the possibility of reducing electron scattering and the internal voltage drop needed for volume ionization. Author (TAB)

N67-15986*# TRW Systems, Cocoa Beach, Fla.
ELECTRICAL DETONATORS AND SQUIBS AND THEIR ASSOCIATED INITIATION AND IGNITION TRAINS
S. H. Rush *In its* Explosive Safety Executive Lecture Ser. Jun. 1965 14 p (See N67-15981 06-34) CFSTI: HC $3.00/MF $0.65

Various aspects of ordnance system safety engineering are discussed, and the terms initiator, squib, and detonator are defined. Two types of primary safing device, whose purpose it is to break the electrical circuit to the initiator, are described, i.e., the arm–disarm switch and the safe and arm device. Safety criteria for ordnance components are summarized as they apply to the safing devices, and safety requirements placed on missile wiring circuits are outlined. The two types of destruct system (one providing a capability to command destruct the vehicle and the other serving a premature stage separation destruct function) are described. Potential hazards to electroexplosive devices by test equipment, electrostatic discharge, electromagnetic fields, and induced voltages are discussed and possible solutions to these hazards are considered. It is emphasized that testing and analysis of the ordnance system to assure safety and reliability must be done on a total basis, rather than by individual components. L.E.W.

N67-15991*# TRW Systems, Cocoa Beach, Fla.
STATIC ELECTRICITY AND LIGHTNING HAZARDS, PART II
G. J. Bryan *In its* Explosive Safety Executive Lecture Ser. Jun. 1965 9 p (See N67-15981 06-34) CFSTI: HC $3.00/MF $0.65

Safe-and-arm devices or careful grounding plus other protective techniques must be used to prevent static electricity and lightning from initiating squibs or detonators and damaging electronic equipment. Such dangers are particularly present for handling of liquid propellants and solvents and other operations for which there is the possibility of initiating fires or explosions in the vapors and dust. Particular attention is given to lightning safety, with ground-to-cloud and cloud-to-ground as well as tornado-type phenomena detailed. Mention is made of squib and detonator sensitivity, as well as their accidental initiation by static electricity. M.W.R.

N67-15992# Globe-Union, Inc., Milwaukee, Wis. Applied Research Labs.
LITHIUM–MOIST AIR BATTERY Interim Report
Jorge E. A. Toni, Guy D. Mc Donald, and William E. Elliott Oct. 1966 94 p refs
(Contract DA-44-009-AMC-1552(T))
(SAR-1; AD-642248) CFSTI: HC $3.00/MF $0.65

The purpose of the first six months work in this program was to determine, insofar as possible, the feasibility of the three principal components of a lithium–moist air battery system, i.e., anode, cathode, and electrolyte. From the work done during this period, it is concluded that at low current density the lithium air cell is feasible. Oxygen reduction is shown to occur in two steps in 1m lithium perchlorate nitrosodimethylamine on a platinum electrode, at −0.6v and −1.75v versus Ag/AgCl. The current obtainable with an air electrode appears to be determined by the rate of absorption of oxygen at the electrode surface and by the rate of mass transport of oxygen to the electrode surface. Unfortunately, these studies have been somewhat impeded by the presence of some electrochemically active species in the electrolyte which competes with oxygen for sites on the electrode surface. The work carried out in the first six months is largely exploratory and more detailed studies are required before the air electrode in nonaqueous electrolyte will be completely characterized. Author (TAB)

N67-16055* General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section.
POTASSIUM MULTIPLE-TUBE TEST CONDENSER DESIGN STUDY Topical Report
F. E. Tippets, J. R. Peterson, and J. G. Sawochka 1966 55 p refs
(Contract NAS3-2528)
(NASA-CR-72137) CFSTI: HC $3.00/MF $0.65 CSCL 10B

Among the results obtained by the NASA-sponsored Alkali Metals Boiling and Condensing Heat Transfer Investigation are a substantial amount of basic heat transfer data on forced convection condensing of potassium in single tubes. These data provide a reasonable basis for thermal design of condensers applicable to Rankine cycle space power systems using potassium as the working fluid. The facility considered has a thermal power capability of 300 KW. This facility is constructed of Haynes-25 alloy and is applicable since it is potentially capable of providing potassium vapor to the test condensers over a range of vapor qualities and temperatures anticipated for Advanced Rankine cycle space power systems. Emphasized are the results of the analytical and conceptual design studies for the condensers. Design of the modificatons to an existing facility for testing these condensers is described, and thermal design analysis procedures and associated digital computer codes developed for multiple-tube condensers and boilers are also given. Author

N67-16062*# Pennsylvania State Univ., University Park. Coll. of Engineering.
HYDRAULIC STEPPING MOTOR
G. J. Gaskill *In its* Systems and Controls Lab. Oct. 1966 p 1–2 (See N67-16061 06-10) CFSTI: HC $3.00/MF $0.65

During this period the prototype motor was constructed. The cams are being produced on a contour following milling machine. Experimental instrumentation was installed to read output shaft angular velocity and position. Air was selected as the working fluid for the initial testing phase and an air spring device as a driver. The device's large effective area gives a large displacement resulting in high demanded flow rates at cycle times near the motor's design limits. The effect of variation in drive force frequency was investigated with an analog computer. Some analog results are given which show reasonable response at widely varying frequencies. Performance is erratic at frequencies under 400 rad/sec. R.N.A.

N67-16063*# Pennsylvania State Univ., University Park. Coll. of Engineering.
SPREADING OF SEMI-CONFINED JETS
R. Bettoli *In its* Systems and Controls Lab. Oct. 1966 p 2–3 (See N67-16061 06-10) CFSTI: HC $3.00/MF $0.65

The effects of aspect ratio of a rectangular jet formed by a nozzle bounded by flat top and bottom plates and converging side walls with different profiles were investigated. Most of the work was done using a round profile with aspect ratios of 4, 2, and 1. Two sharp-edge nozzle profiles were also studied. A uniform velocity was found all across the outlet of the round nozzle for all three aspect ratios. The vertical traverses of the mean velocity taken downstream of the nozzle exhibit a highly three-dimensional behavior of the flow. For the two sharp-edged nozzles, horizontal and vertical traverse profiles similar to the ones found for the round nozzles were discovered. Their magnitude and positioning, as well as the spreading of the jet, are influenced by the shape of the nozzle. R.N.A.

N67-16064*# Pennsylvania State Univ., University Park. Coll. of Engineering.
THERMAL SWITCHING OF FLUIDIC ELEMENTS
R. E. Tomek *In its* Systems and Controls Lab. Oct. 1966 p 4 (See N67-16061 06-10) CFSTI: HC $3.00/MF $0.65

The inherent high reliability of fluidics devices is compromised by the need for electro-mechanical switches which direct the supply of control fluid to the fluidics devices. Studies are briefly described which are being conducted to develop methods whereby the electrical signal from a computer can produce thermal fluidic switching. R.N.A.

N67-16065*# Pennsylvania State Univ., University Park. Coll. of Engineering.
FLUID TRANSMISSION LINE DYNAMICS
R. G. Leonard *In its* Systems and Controls Lab. Oct. 1966 p 4–5 (See N67-16061 06-10) CFSTI: HC $3.00/MF $0.65

The performance of various distributed parameter components which constitute many fluid control systems and computer models for these components are being investigated. The models are needed for stability analyses, speed of response determination, frequency response analyses, investigations of transient pressure surges, the development of schemes to suppress undesirable transient performance, and the matching of transmission lines with the remainder of a fluid system. A digital technique was selected to simulate the transport delay associated with the propagaton of a pressure wave along a fluid line. The equipment was designed and is being installed. A schematic diagram and photograph of the system are included. R.N.A

N67-16069*# Pennsylvania State Univ., University Park. Coll. of Engineering.
SIZE AND DIRECTION OF JETS ISSUING FROM TWO-DIMENSIONAL ASYMMETRIC ORIFICES
J. L. Shearer *In its* Systems and Controls Lab. Oct. 1966 p 14 (See N67-16061 06-10) CFSTI: HC $3.00/MF $0.65

Work is described which employed the method of force defect coefficients in determining size and direction of ideal jets issuing from asymmetric orifices into a region of uniform pressure. Both compressible and incompressible flows were studied, but the effects of fluid viscosity and entrainment of surrounding fluid were ignored. Results compared well with experiments that used a Schlieren light system to show up the jet edges. A second phase of the work involved extending the method of force defect coefficients to the case of asymmetric pressure conditions in the region surrounding the issuing jet. A relaxation solution was conducted in the hodograph plane using a digital computer. In twenty complete cycles of computation the relaxation method appears to be converging on a reasonably good answer. R.N.A.

N67-16070*# Pennsylvania State Univ., University Park. Coll. of Engineering.
CHARACTERISTICS OF PRESSURE CONTROLLED FLUID JET AMPLIFIERS
A. K. Stiffler *In its* Systems and Controls Lab. Oct. 1966 p 14–15 (See N67-16061 06-10) CFSTI: HC $3.00/MF $0.65

Previous work on knife edge type fluid amplifiers included a study of a device of a particular design which was conducted because preliminary results differed considerably from those of Simson's analysis of similar amplifiers. These results, which differed in that gains were about three times higher and quiescent control flows were about twice as large as prdicted by Simson, are discussed. Efforts on developing dynamic models of fluid amplifiers are also discussed. R.N.A.

N67-16071*# Pennsylvania State Univ., University Park. Coll. of Engineering.
SIGNAL NOISE IN FLUID AMPLIFIERS
J. C. Tamulis *In its* Systems and Controls Lab. Oct. 1966 p 15–25 (See N67-16061 06-10) CFSTI: HC $3.00/MF $0.65

A presentation is made of digital data, results, and conclusions concerning power density spectra obtained from a continuing investigation of basic sources of noise in fluid amplifiers. R.N.A.

N67-16436# Rocketdyne, Canoga Park, Calif.
TURBINE PERFORMANCE PREDICTION: OPTIMIZATION USING FLUID DYNAMIC CRITERIA Final Report, 1 Jun. 1964–1 Dec. 1966
O. E. Balje and R. L. Binsley 1 Dec. 1966 242 p refs
(Contract Nonr-4507(00))
(R-6805; AD-642767) CFSTI: HC $3.00/MF $0.65

The report presents the results of a study program for the prediction of turbine performance. Optimum turbine design diagrams are included for full- and partial-admission axial-flow turbines, and radial inflow turbines. Author (TAB)

N67-16469# Mallory (P. R.) and Co., Inc., Burlington, Mass. Lab. for Physical Science.
EVALUATION OF RECHARGEABLE LITHIUM–COPPER CHLORIDE ORGANIC ELECTROLYTE BATTERY SYSTEM
M. L. B. Rao and K. R. Hill 15 Sep. 1966 80 p refs
(Contract DA-44-009-AMC-1537(T))
(TR-1; AD-643378) CFSTI: HC $3.00/MF $0.65

The electroformation and discharge of lithium and copper chloride in 1m $LiAlCl^4$ in propylene carbonate was investigated to evaluate the lithium–copper chloride high energy density battery system. The utilization efficiency of lithium depended on the substrate, the current density and the loading. The operation of a rechargeable cupric chloride electrode is possible under suitable conditions. Impurities present in solution caused a significant self-discharge of lithium and increased the copper salt solubility. The formation of highly soluble chloro-cuprate complexes of copper salts during discharge was found to be the principal mechanism resulting in loss of cathode efficiency. Author (TAB)

N67-16544*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A FUNCTIONALLY-INTEGRATED CONTROLLER-COMMUTATOR FOR USE IN BRUSHLESS DIRECT-DRIVE SOLAR ARTOR FOR USE IN BRUSHLESS DIRECT-DRIVE SOLAR ARRAY REORIENTATION SYSTEMS
L. J. Veillette Sep. 1966 54 p refs
(NASA-TM-X-55641; X-716-66-473) CFSTI: HC $3.00/MF $0.65
CSCL 10B

Solutions to the specialized problems arising in the design of the reorientation system are presented. A simple active magnetic sensing method is described which derives position and rate information directly from the solar array output shaft. The angular resolution and rate-sensitivity available from the sensor are suitable for providing controlled-damping and rate-limiting of the solar array at orbital rates. The sensor rate sensing capability is integrated into the commutator simply by appropriately selecting the geometric proportions of the sensor magnetic structure. Expressions derived for the sensor gain, bandwidth, and driving-point impedances show that increase of the sensor minimum bandwidth is obtained at the expense of increased input drive requirements, reduced low-frequency gain, or reduced output loading. Bidirectional drive of the solar array is obtained in a single sensor by employing a phase-controlled logic technique to establish the torque motor armature switching sequences. Boolean excitation and connection matrices and winding vectors for implementing the logical design are derived. Torque/speed control integrated into the commutator with practically no penalty in added circuit complexity. Author

N67-16562*# Harshaw Chemical Co., Cleveland, Ohio.
RESEARCH AND DEVELOPMENT IN CdS PHOTOVOLTAIC CELLS Final Report, 28 Jun. 1965–27 Jun. 1966
James C. Schaefer, E. R. Hill, and T. A. Griffin 27 Jun. 1966 82 p refs
(Contract NAS3-7631)
(NASA-CR-72144) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Additional research and developmental studies were made on the CdS thin film solar cell. Several previously unreported cell characteristics are discussed such as: I-V curve hysteresis, reversible changes due to forward and reverse bias, changes of spectral response with temperature and bulk properties, and cell capacitance as a function of reverse bias. These results lend support to the E. Hill CdS solar cell model. Vapor transported CdS film, high reliability electroplated grid collectors and CdS surface treatments are also discussed. Highest reported cell energy conversion efficiency was 6.9%. Author

N67-16563*# TRW Equipment Labs., Cleveland, Ohio.
STUDY OF ASBESTOS FOR ELECTROCHEMICAL CELLS First Summary Report
J. W. Vogt 28 Dec. 1966 66 p
(Contract NAS3-8522)
(NASA-CR-72148) CFSTI: HC $3.00/MF $0.65 CSCL 10A

A program designed to characterize a fuel cell grade asbestos presently used in electro-chemical cells, and to examine other asbestoses and different inorganic fibrous materials in search for a superior material for cell separator application; is reported. Presented are results of tests of chrysotile fuel cell asbestos. The chrysotile paper and millboard were tested to yield quantitative values for the physical and chemical properties which pertain to their performance as an electrolyte matrix material. These tests ranged from tests of the basic material and fiber properties to studies of the behavior of the saturated mat in an electrolytic conductor. Discussed are results of tests of asbestos fiber properties, dry mat properties, wet mat properties (wet with KOH electrolyte), chemical degradation, and electrochemical degradation. S.C.W.

N67-16565*# Pratt and Whitney Aircraft, East Hartford, Conn.
TURBINE RESEARCH PACKAGE FOR RESEARCH AND DEVELOPMENT OF HIGH PERFORMANCE AXIAL FLOW TURBINE-COMPRESSOR Final Report
R. Cohen, W. K. Gilroy and F. D. Havens Dec. 1966 74 p refs
(Contract NAS3-4179)
(NASA-CR-54883; PWA-2822) CFSTI: HC $3.00/MF $0.65 CSCL 10A

The turbine research package is a test rig intended to provide cold-flow aerodynamic performance data for the Brayton-cycle compressor drive turbine. This turbine is a single-stage axial-flow unit designed to provide a high efficiency potential. The turbine research package was designed to provide a convenient mechanical configuration for aerodynamic testing. This unit was constructed and tested mechanically to 20% above its design speed. It demonstrated satisfactory mechanical characteristics and completed the required acceptance test. Particular design objectives included high mechanical integrity, versatility, and ease of assembly and disassembly. The package is capable of operating at speeds in excess of 120% of design speed, at inlet temperatures as high as 710°R, and inlet pressures as high as 23 psia. Described are specific turbine design conditions for the turbine-compressor, design conditions for the turbine research package, the turbine research package. A discussion of results of mechanical testing is also included. S.C.W.

N67-16609*# American Univ., Washington, D. C.
RESEARCH INTO FUNDAMENTAL PHENOMENA ASSOCIATED WITH SPACECRAFT ELECTROCHEMICAL DEVICES—CALORIMETRY OF NICKEL–CADMIUM CELL Progress Report, Jan. 1–Sep. 30, 1966
W. H. Webster and R. T. Foley 30 Sep. 1966 96 p refs
(Contract NAS5-10105)
(NASA-CR-81350; PR-1) CFSTI: HC $3.00/MF $0.65 CSCL 10C

The program has been directed toward the design and development of an isothermal continuous flow calorimeter capable of measuring the thermal characteristics of batteries undergoing typical orbital cycling. An isothermal continuous flow calorimeter was developed and calibrated over the range of 0.10 to 1.00 watt which range is characteristic of the thermal output of a six ampere-hour nickel-cadmium cell. The thermal response was found to be linear in this range and the instrument was sensitive to 0.01 watt. During testing the oxygen pressure in the cell and the rate of heat generation by the cell was recorded. The enthalpy changes (ΔH) corresponding to the reactions occurring during the charge and discharge processes were calculated from the thermal data. These values were in excellent agreement with the literature values for these reactions. Author

N67-16625* Electro-Optical Systems, Inc., Pasadena, Calif.
SILICON SOLAR CELLS FOR NEAR-SUN MISSIONS
S. Friedlander, S. Kaye, and G. P. Rolik [1965] 81 p refs
(Contract NAS2-3613)
(NASA-CR-73062) CFSTI: HC $3.00 CSCL 10B

An analysis was performed of the necessary requirements of solar cells to operate in a near-sun mission at 0.2 AU. A computer evaluation was made of all known cell parameters, taking into account the controllable variables in cell manufacture, with the objective of optimizing the short-circuit current at 1-sun intensity, open circuit voltage at 25-sun intensity, and maximum power over all intensities. Definitive specifications of materials and processing procedures (including integral quartz covers) were defined for the fabrication of prototype cells, with the characteristics established during the analysis as a design goal. A sufficient number of cells having such characteristics was fabricated and tested at up to a 10-sun intensity to prove the feasibility of the design. Author

N67-16628*# Bureau of Mines, Pittsburgh, Pa. Coal Research Center.
DEVELOPMENT OF AN IMPROVED OXYGEN ELECTRODE FOR USE IN ALKALINE H_2-O_2 FUEL CELLS Quarterly Report, Oct. 1–Dec. 31, 1966
D. Bienstock, Sayeed Akhtar, and C. T. Grein 31 Dec. 1966 17 p refs
(NASA Order W-12300)
(NASA-CR-81337; Q-2) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Preparation and synthesis of the following compounds is reported: (1) epsilon, chi, and theta-iron nitrocarbides; (2) epsilon and gamma-iron carbonitrides; (3) chi-iron carbides and the corresponding nitrocarbides from coprecipitated mixtures of iron and silver in the weight ratios of 3/1, 1/1, and 1/3 iron to silver; and (4) carbides of cobalt and nickel. Briefly described are the operation of an induction furnace and the preparation of three Raney alloys of Co–Ni in the weight ratios of 3/1, 1/1, and 1/3, and of one Raney alloy of 1Ni–3Ag. K.W.

N67-16636* Matrix Research and Development Corp., Nashua, N. H.
DESIGN AND DEVELOPMENT OF A NON-DISSIPATIVE CHARGE CONTROLLER USING A ROTARY TRANSFORMER Final Report

[1966] 190 p refs
(Contract NAS5-9204)
(NASA-CR-81365; M2139P800C) CFSTI: HC $3.00 CSCL 10B

A non-dissipative charge controller was designed to provide a more efficient means of utilizing output of a solar array for powering a spacecraft's battery and electronics. The design incorporates a rotary transformer to couple the power from a rotatable solar array to the spacecraft, thereby eliminating the need for slip rings. The charge controller and its evolution are covered in detail, and a discussion of the development of each major component and circuit of the system is included. A circuit description of the final breadboard, a discussion of the spacecraft power simulator, and a description of the testing done on the breadboard are also given. The major conclusion reached during the study was that the use of a rotary power transformer and a maximum power sensing and controlling converter are practical for satellite power systems. A.G.O.

N67-16637*# Unified Science Associates, Inc., Pasadena, Calif.
GASEOUS ELECTROLYTES FOR BATTERIES AND FUEL CELLS Firest Quarterly Report, 1 Aug.–30 Oct. 1966
S. Naiditch 30 Oct. 1966 27 p ref
(Contract NAS7-437)
(NASA-CR-81366; QR-1) CFSTI: HC $3.00 CSCL 10C

Examined was electrode behavior in NH_3 at elevated temperatures. Two cells were prepared and filled. The first cell consisted of four $Cd(Hg)/CdCl_2$ electrodes. This cell was run for 20 days from room temperature to 93°C and back to room temperature. The data obtained were erratic during the heating cycle and still not satisfactory on the cooling cycle. In the second cell, a solid lead/$PbCl_2$ electrode was used. This cell was run for 28 days from room temperatur to 100°C. The $Pb/PbCl_2$ appeared to be well behaved and better than a $7n(Hg)/ZnCl_2$ electrode in the small cell. Experiments were begun to uncover differences in steady state and transient behavior at the electrode-solution interface when changing the electrolyte from the liquid to the gaseous state. A cell was fabricated to plate out silver onto one cathode from an $AgNO_3(NH_3)$ solution at room temperature and onto another cathode from electrolyte in the dense gaseous state. In the first run, plating from the liquid was satisfactory, but not from the gas. In the latter, a heavy metallic silver sludge plated out in the wrong region of the cell. The cell was redesigned and filled. Author

N67-16638*# Gulton Industries, Inc., Hawthorne, Calif. Engineered Magnetics Div.
OPTIMUM CHARGING SYSTEM STUDY PROGRAM Final Report
G. Gladstone and J. Yuh 1 Aug. 1966 105 p
(Contract NAS5-3785)
(NASA-CR-81367; Rept.-1906) CFSTI: HC $3.00 CSCL 10C

The complete study program for the design, development and performance of an Optimum Charging System is summarized. Two Ampere-Hour Meter Taper Charge System breadboards were designed, fabricated and tested. These breadboards use an Ampere-Hour Meter as the controlling device to charge nickel-cadmium batteries. A Solar Array Simulator was also developed to simulate the actual Solar Array for test functions. Described are the design, fabrication and testing of an Adhydrode-Optimum Tracking System breadboard which utilizes the Adhydrode Voltages of the Adhydrode Battery Cells for the charge controlling factor in lieu of the Ampere-Hour Meter controlling device. The Adhydrode-Optimum Tracking System contains a Maximum Power Tracker circuit to attain optimum power transference to the battery. The Ampere-Hour Meter Taper Charge System was modified to serve as a back-up to the Adhydrode-Optimum Tracking System and simultaneously furnishes a signal that can be converted to ampere-hours with calibration curves. Author

N67-16640*# Gulton Industries, Inc., Metuchen, N. J.
HERMETICALLY SEALED CELLS CAPABLE OF OVERDISCHARGE AS WELL AS OVERCHARGE
Paul Ritterman May 1964 44 p
(Contract NAS5-3667)
(NASA-CR-81369) CFSTI: HC $3.00/MF $0.65 CSCL 10C

Purpose of this work was to produce hermetically sealed cells that are (1) protected against overcharge by an auxiliary electrode, and (2) protected against overdischarge. Cells were constructed which can withstand an overdischarge for over 250 cycles without developing pressures above 50 psig. Sealed nickel-cadmium cells were constructed which can be overdischarged at room, elevated, and low temperatures. Two modes of oxygen recombination during overdischarge of sealed nickel-cadmium cells are discussed. Cells which will give overcharge as well as overdischarge protection were also constructed. After some cycling, the overcharge protection in these particular cells failed. It is thought that this can easily be rectified by slight changes in cell construction. K.W.

N67-16679*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THERMODYNAMIC AND TURBINE CHARACTERISTICS OF HYDROGEN-FUELED OPEN-CYCLE AUXILIARY SPACE POWER SYSTEMS
Michael R. Vanco Washington, NASA, Jan. 1967 27 p refs
(NASA-TM-X-1337) CFSTI: HC $3.00/MF $0.65 CSCL 10A

An analytical study was conducted to determine the characteristics of turbine-driven hydrogen-fueled auxiliary space power systems. The oxidizers considered for these systems were oxygen and fluorine. The thermodynamic characteristics were examined in terms of specific propellant consumption, oxidizer-to-fuel ratio, and specific volume consumption. The turbine characteristics required by the thermodynamic conditions of interest were then studied in terms of stage number, blade speed, flow area, and stress. Because high-turbine-pressure ratios can be obtained by venting the exhaust to space, system ideal specific propellant consumptions of less than 1 pound per horsepower-hour can be achieved. Ideal specific propellant consumption decreases to a minimum and then increases as turbine-inlet temperature increases. The optimum temperature exceeds 5000°R. If the turbine-inlet temperature is restricted to 2500°R by material consideration, there are significant increases in specific propellant consumption and specific volume consumption over those at the optimum temperature. An improvement in specific propellant consumption is obtained by using a recuperated system; there is, however, no significant change in the specific volume consumption. Author

N67-16680*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPUTER PROGRAM FOR THERMODYNAMIC PERFORMANCE OF BRAYTON-CYCLE SPACE-POWER SYSTEMS
Arthur J. Glassman Washington, NASA, Jan. 1967 27 p refs
(NASA-TM-X-1339) CFSTI: HC $3.00/MF $0.65 CSCL 10A

A computer program used for the calculation of the thermodynamic performance of one- and two-shaft Brayton-cycle space-power systems is presented. Systems that can be analyzed include those with and without reheating and/or intercooling. Provision is made in the program to account for turbine-coolant flow. Inputs required for the program include the component performance parameters and the cycle temperature variables. Performance outputs from the program include cycle efficiency and prime radiator area. Sample input and output are presented to demonstrate the use of the program. Author

N67-16897*# Electric Storage Battery Co., Raleigh, N. C. Missile Battery Div.
RESEARCH AND DEVELOPMENT OF CELLS WITH BELLOWS CONTROLLED ELECTROLYTE LEVELS Final Progress Report, May 11, 1965–Apr. 1, 1966
F. S. Cushing and A. M. Chreitzberg 1 Apr. 1966 82 p refs
(Contract NAS5-3813)
(NASA-CR-81380; E-13-66; FPR-4) CFSTI: HC $3.00/MF $0.65
CSCL 10C

Control of electrolyte level in sealed Ni–Cd and Ag–Cd cells with bellows action was demonstrated in 8-hour and 24-hour orbit tests over the temperature range 0°C–40°C. Bellows installed in the bottom of cell cavities collapse as cell pressures increase near the end of charge allowing electrolyte levels to fall under gravity action, exposing greater negative plate and oxygen electrode area. Recombination rates were limited by rate and degree of electrolyte drainage from cell packs. In sealed Ni–Cd cells optimum performance was achieved with 20% KOH electrolyte and woven cloth separators. In sealed Ag–Cd cells closed "U" folds of semipermeable membranes could not be drained. Oxygen recombination rates on exposed negative and oxygen electrodes were enhanced by drainage of electrolyte from bellows action. A survey of metal bellows was made to locate an efficient design. A stack of rectangular plastic film pillows proved to be more efficient in weight, volume, and volume change per unit volume. Optimum designs were incorporated in 8-A.H. and 100-A.H. Ag–Cd sealed cells for deliverable hardware. The 100-A.H. cell contains a special metal bellows with an internal normally closed switch actuated by high cell pressure to terminate charge. Author

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N67-15357# Harvard Univ., Cambridge, Mass. Biological Labs.
[ANALYSIS OF COLOR VISION MECHANISMS] Final Report
George Wald 6 Oct. 1966 5 p refs
(Contract Nonr-1866(38))
(AD-640714) CFSTI: HC $3.00/MF $0.65

Summary data are presented on several laboratory investigations of color vision mechanisms. Among the findings reported are: (1) Microspectrophotometric measurements of the color vision pigments in single parafoveal cones of the human retina suggest that some red cones may contain mixtures of the red and green sensitive pigments. (2) Psychophysical measurements on human subjects, using the method of selective adaptation with bright colored backgrounds, isolated the action spectra of the three color vision pigments in the fovea. It was found that the red and green sensitive pigments contribute almost equally to the overall sensitivity of the fovea; the blue sensitive pigment only slightly. A bibliography of general and theoretical papers related to the research is included. M.G.J.

N67-15360# Ohio State Univ. Research Foundation, Columbus.
VISUAL RECOVERY FROM HIGH INTENSITY FLASHES II Final Report, 15 May 1965–15 May 1966
Norma D. Miller Brooks AFB, Tex., School of Aerospace Med., Jul. 1966 65 p refs
(Contract AF 41(609)-2426)
(AD-64231) CFSTI: HC $3.00/MF $0.65

Some new instrumentation was developed and a number of refinements were made in the existing special test equipment for investigating the visual recovery following high intensity flashes. The primary areas of apparatus modification were (1) increased capability for the measurement of source energy in absolute units, (2) increased precision in the measurement of recovery times, (3) extended range of flash durations for recovery measurements, and (4) inclusion of pupillographic recording as a measure of flash effect. The consensual pupil reflex was measured for six subjects for flash energies from 150,000 to 30,000,000 td.sec. The flash durations were varied from 250 microsec to 1.5 sec. Flash fields subtended a visual angle of 7.5 degrees in most of the work with a 2 degree centrally fixated field used in one part of the study. Author (TAB)

N67-15406# Army Medical Research Lab., Fort Knox, Ky.
THE LATERAL GENICOLATE COMPLEX OF THE OWL MONKEY *AOTES TRIVIRGATUS*
Arthur E. Jones 13 Jun. 1966 17 p refs Repr. from J. Comp. Neurol., v. 126, no. 2, Feb. 1966 p 171–179
(Grant NSF-24125
(USAMRL-669; AD-640667)

The owl monkey is the only nocturnal monkey and possesses a pure rod retina. The lack of retinal cones and the apparent achromatic visual behavior of the animal suggest that any anatomical substrate of primate color vision in the higher visual centers should be missing in the owl monkey. The lateral geniculate nucleus of Aotes is composed of four lamina and the LGN of trichromatic Macaca six. The pregeniculate nucleus of Aotes is composed of two lamina and that of Macaca one. The nucleus intergeniculatus of Ateles (also a trichromatic species) and Macaca is a ventral extension of the pulvinar in Aotes. A 1:1 relationship between retinal ganglion cells and LGN cells is found in Aotes, but is probably not found in Macaca. Author (TAB)

N67-15409# David Taylor Model Basin, Washington, D. C. Structural Mechanics Lab.
EFFECTS OF OVERPRESSURE ON THE EAR
Arthur E. Hirsch Aug. 1966 14 p refs
(DTMB-2252; AD-640921) CFSTI: HC $3.00/MF $0.65

Tolerance levels of the human ear to various types of overpressure are discussed. Author (TAB)

N67-15430*# Israel Program for Scientific Translations, Ltd., Jerusalem.
LIFE PHENOMENA—A HISTORICAL SURVEY
1966 178 p refs Transl. into ENGLISH of the book "Fizicheskie i Khimicheskie Osnovy Zhiznennykh Yavlenii— Istoricheskie Ocherki" Moscow, Izd. Akad. Nauk SSSR, 1963 Published for NASA and NSF
(NASA-TT-F-381; TT-66-51018) CFSTI: HC $3.00/MF $0.65
CSCL 06C

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N67-15431*# Israel Program for Scientific Translations, Ltd., Jerusalem.

THE DEVELOPMENT OF NOTIONS ON THE MATERIAL BASIS OF LIVING STRUCTURES, FROM ANTIQUITY TO THE BEGINNING OF THE 20TH CENTURY

L. Ya. Blyakher *In its* Life Phenomena—A Historical Surv. 1966 p 3–44 refs (see N67-15430 06-04) CFSTI: HC $3.00/MF $0.65

A historical review of the orderly occurrences and origins of biological processes, ancient cytological concepts, and speculative theories on living organisms is presented. Notations are reported on the discreteness of matter in animate bodies during the 17th and 18th centuries. The discovery of biological cells, and early attempts to explain their structure and chemical composition, as well as hypotheses on the nature of protoplasm and of bearers of vital characteristics within the cell are also included. Theories based on the assumption of the existence of representative particles are recapitulated among other attempts to develop an idea of the substrata of vital phenomena. An extensive bibliography follows. R.Li.

N67-15432*# Israel Program for Scientific Translations, Ltd., Jerusalem.

ORIGIN, DEVELOPMENT AND PROSPECTS OF THE THEORY OF THE BIOLOGICAL FIELD

L. V. Belousov *In its* Life Phenomena—A Historical Surv. 1966 p 45–91 refs (See N67-15430 06-04) CFSTI: HC $3.00/MF $0.65

The biological field theory in relation to embryological and biological cell concepts is reviewed. The field principles establish the presence or absence of a connection between the most variegated initial influences and the form of the embryo, without dealing with the problem of the creation of this form out of deliberately nonvectorial influences. A survey of the developmental course of purely experimental embryology over the last 20–30 years, seen from the point of view of the field, leads to the conclusion of the growth of evidence of the autonomous, yet reciprocal, character of the components of morphogenesis. An extensive bibliography is included to augment the discussion points. R.Li.

N67-15433*# Israel Program for Scientific Translations, Ltd., Jerusalem.

THE BIRTH OF ELECTROCARDIOGRAPHY IN RUSSIA

N. A. Grigoryan *In its* Life Phenomena—A Historical Surv. 1966 p 92–115 refs (See N67-15430 06-04) CFSTI: HC $3.00/MF $0.65

Electrocardiography is reviewed from the historical standpoint, and bibliographical references are provided in an attempt to overcome the literature deficiency in the U.S.S.R. on the historical development of that science. The construction of the string galvanometer and the curve of human cardiac currents obtained with it are considered a milestone in clinical physiology. R.Li.

N67-15434*# Israel Program for Scientific Translations, Ltd., Jerusalem.

V. N. LYUBIMENKO'S STUDIES OF CHLOROPHYLL AND THEIR MODERN DEVELOPMENT

E. M. Senchenkova *In its* Life Phenomena—A Historical Surv. 1966 p 116–171 refs (See N67-15430 06-04) CFSTI: HC $3.00/MF $0.65

Chlorophyll, photosynthesis, and their scientific development are reviewed from open literature sources. Some topics discussed are: chlorophyll, an intricate protein complex; nature of chlorophyllogen and protochlorophyll in plants and the prerequisites of their formation; patterns of chlorophyll biosynthesis and the role of protochlorophyll in this process; influence of external factors on synthesis and accumulation of chlorophyll; quantitative variability of chlorophyll; chromatic adaptation; fossil chlorophyll; and, chlorophyll and heredity of plants. R.Li.

N67-15545# Atomic Energy Commission, Washington, D. C. Div. of Biology and Medicine.

RADIOTHERAPY

H. D. Bruner *In* Du Pont Large Scale Production and Appl. of Radioisotopes May 1966 19 p refs (See N67-15525 06-22) CFSTI: HC $3.00/MF $0.65

Technological progress and trends in the field of radiation therapy for medical purposes are surveyed. The following are highlighted: electromagnetic radiation treatment of disease, radio therapy for cancer, increasing knowledge of biomedical effects of radiations, better understanding of the interactions of radiations with living tissues and of dosimetric principles, and the effectiveness of a particular type of radiation therapy. Technical data describe: experimental and standard devices and systems producing ionizing radiations, such as: orthotherapy X-ray machines with 250 to 400 kV peak energy and dose rates of up to 500 Roentgens per minute at working distances up to 1 meter; ^{60}Co and ^{137}Cs teletherapy machine; super-voltage X-ray machines; tiny yttrium-90 beads deposited in the pituitary gland by needles through nasal passages; as well as ^{90}Sr-^{90}Y tipped needles inserted into human pain-conducting bundles, and for pituitary destruction purposes. Future possibilities of neutron dosimetry are also briefly outlined. R.Li.

N67-15550*# National Aeronautics and Space Administration, Washington, D. C.

ON THE DEVELOPMENT OF X-RAY INJURIES TO THE SKIN [K VOPROSU O RAZVITII RENTGENOVSKIKH PORAZHENIY KOZHI]

L. A. Afrikanova Dec. 1966 8 p Transl. into ENGLISH from the book "Trudy Vsesoyuznoy Konferentsii Patologoanatomoy" Leningrad, 1956 p 332–337

(NASA-TT-F-10630) CFSTI: HC $3.00/MF $0.65 CSCL 06R

Present-day and historical concepts and directions in the study of the pathological process of X-ray injuries to the skin are summarized, and compared with the author's findings. The article evaluates changes in the afferent side of the reflex arc providing innervation to the irradiated sector of skin (nose & lip of cat). Study conditions and parameters are specified, and changes occurring 10 min to 3 weeks and 2 months after specimen exposure are exhaustively examined. The author details his disagreement with most investigators that radiation damage to skin consists of selective injury of vessel walls by radiation energy. Author

N67-15553*# National Aeronautics and Space Administration, Washington, D. C.

CHANGES IN THE PERIPHERAL DIVISION OF THE AUDITORY ANALYZER IN ACUTE RADIATION SICKNESS [IZMENENIYE PERIFERICHESKOGO OTDELA SLUKHOVOGO ANALIZATORA PRI OSTROY LUCHEVOY BOLEZNI]

M. Ya. Kozlov Oct. 1966 11 p refs Transl. into ENGLISH from Vestn. Otorinolaringol. (Moscow), v. 20, no. 2, 1958 p 29–35

(NASA-TT-F-10361) CFSTI: HC $3.00/MF $0.65 CSCL 06R

The function of the peripheral section of the auditory analyzer in guinea pigs was estimated with the aid of leads and recording of bioelectricity of the cochlea. In the first group of experiments (10 animals), quantitative evaluation of hearing was carried out. The second group underwent total X-ray irradiation with the dose of 350 R; subsequently, at the height of radiation sickness hearing was evaluated by the same method as above. The ability to hear decreased, on the average, from 3.9 to 9.1 dB. Author

N67-15555*# National Aeronautics and Space Administration, Washington, D. C.

A SYSTEM FOR THE GENERATION OF MONOCHROMATIC RADIATION FOR PHOTO-BIOLOGICAL INVESTIGATIONS [EINE ANLAGE ZUR ERZEUGUNG MONOCHROMATISCHER STRAHLUNG FUER PHOTOBIOLOGISCHE UNTERSUCHUNGEN]

G. Schoser Oct. 1966 8 p refs Transl. into ENGLISH from German

(NASA-TT-F-10367) CFSTI: HC $3.00/MF $0.65 CSCL 06B

The author describe a recently designed interference-filter monochromator system for biological investigations. The spectral range is from 400–800 nm; the system consists of 16 monochromator units. The output obtained previously by middle-volt projectors (110 V/750 w) is reached here at much lower cost and with much less optical equipment. It operates with newly developed ellipsoid reflector lamps (12 V/150 w, Osram) as the radiation source. Each unit utilizes a simple optical system. The overall efficiency is as good as that of a high power projector (Prado, 750 w, Leitz). The improvements in interference filters do not still require strictly parallel rays in order to prevent stray losses. With filters of the new design, a deviation of 20° causes a change of 1 nm in the wavelength. This makes the system less sensitive to adjustments. They are made by centering the illuminated area. Author

N67-15560*# National Aeronautics and Space Administration, Washington, D. C.

ISOLATION AND PROPERTIES OF A RNA–DNA COMPLEX FROM *ESCHERICHIA COLI CELLS* [VYDELENIYE I SVOYSTVA KOMPLEKSA RNK–DNK IZ KLETOK *ESCHERICHIA COLI*]

N. S. Vladychenskaya and V. S. Tonguı Oct. 1966 19 p refs Transl. into ENGLISH from Biokhimiya (Moscow), v. 31, no. 3, 1966 p 484–490

(NASA-TT-F-10368) CFSTI: HC $3.00/MF $0.65 CSCL 06A

RNA, not split by ribonuclease, was found in logarithmically growing *E. coli* cells. A preparation containing this RNA and DNA behaves as homogeneous material in an ultracentrifuge and gives a one-step fusion curve. It is concluded that this material is a RNA–DNA complex. The complex can be detected by either the phenol or detergent methods of isolating nucleic acids. During denaturation the complex breaks down into two components, one of which is destroyed by ribonuclease. In cells taken in the ninth hour of growth the complex to all intents and purposes is absent. Author

N67-15560# York Univ., Toronto (Ontario). Molecular Psychobiology Lab.

MOLECULAR NEUROCHEMISTRY OF THE BRAIN DURING CONDITIONED AVOIDANCE BEHAVIOR

John Gaito, James Mottin, Elizabeth Schaeffer, James H. Davison, and Joanne Rigler 14 Oct. 1966 38 p refs

(Contract Nonr-4935(00); Grant NRC APB-110)

(MPL-4; AD-641615) CFSTI: HC $3.00/MF $0.65

Four experiments were conducted to evaluate neurochemical changes in brain tissue of rats in a one way active avoidance conditioning task. The dependent variables were amounts of RNA, DNA, and proteins; ratios of these three; the specific activity of RNA, protein, and tissue pool fractions; and the relative specific activity of RNA and protein fractions. Lower amounts of labelled precursors were found in the tissue pool, RNA, and protein fractions in most brain tissues of learning animals than in control rats. The results concerning individual brain tissues suggested that the medial ventral cortex, and possibly the medial dorsal cortex, play an important role in this type of learning. Author (TAB)

N67-15687*# National Aeronautics and Space Administration, Washington, D. C.

INHIBITION OF RNA SYNTHESIS BY ACTINOMYCIN [O PODAVLENII SINTEZA RNK AKTINOMITSINOM]

S. Yu. Luk'yanov and N. G. Shuppe Oct. 1966 11 p refs Transl. into ENGLISH from Biokhimiya (USSR), v. 31, 1966 P 521–527

(NASA-TT-F-10369) CFSTI: HC $3.00/MF $0.65 CSCL 06A

A study was made of the mechanism of inhibition of RNA synthesis in a cell-free system. It was demonstrated experimentally that the derived quantitative relationships can be used also in the case of intact cells. An estimate is given for the number of guanine–cytosine pairs in the considered DNA section. Under the influence of AM there first will be an inhibition of those RNA molecules which have the greatest molecular weight and whose nucleotide composition includes a relatively large number of guanine–cytosine pairs. This also can be attributed to the fact that AM first inhibits synthesis of ribosomal RNA (high-molecular and guanine–cytosine type), and, second, inhibits the synthesis of messenger RNA (high-molecular, but the AU type) and, thereafter, inhibits the synthesis of transport RNA (low-molecular, but of the guanine–cytosine type). Author

N67-15688*# National Aeronautics and Space Administration, Washington, D. C.

CAROTENE CONTENT IN DUNALIELLA SALINA TEOD. ALGAE UNDER CONDITIONS OF LABORATORY CULTIVATIONS [VMIST KAROTYNU U VODOROSTI DUNALIELLA SALINA TEOD. PRY VYROSHCHUVANNI YIYI V LABORATORNYKH UMOVAKH]

I. G. Drokova, R. Ts. Popova, and N. D. Tup Dec. 1966 11 p refs Transl. into ENGLISH from Ukr. Biokhim. Zh. (Kiev), v. 21, no. 5, 1964 p 44–49

(NASA-TT-F-10433) CFSTI: HC $3.00/MF $0.65 CSCL 06C

The authors show the possibility of accumulating carotene on converting the green form of Dunaliella salina into the red by changing the NaCl concentration in the nutrient medium. The hydrolysate of yeast, ammonium bicarbonate, vitamins B, PP and isovalerianic aldehyde stimulated carotene accumulation in green and red cells; ribonucleic acid furthered the accumulation of green cells without having an unfavorable effect on the process of converting the green cells into red. Author

N67-15700*# National Aeronautics and Space Administration, Washington, D. C.

THE "BIOSPUTNIK" IS CONDUCTING INVESTIGATIONS [BIOSPUTNIK VEDET ISSLEDOVANIYA]

N. Gurovskiy Nov. 1966 5 p Transl. into ENGLISH from Aviats. i Kosmonavt. (Moscow), no. 5, 1966 p 32–34

(NASA-TT-F-10650) CFSTI: HC $3.00/MF $0.65 CSCL 06S

A general discussion is presented of the medical and biological investigation of the regions of intense radiation in the inner radiation belt of the earth. Developments are outlined in view of the launching of the biological satellite Cosmos 110, which has an orbit higher than any manned spacecraft and is intended for a prolonged stay in zones of increased radiation. Discussed in particular are the role of animals aboard the satellite, the effects of cosmic radiation, solar flares, weightlessness, radiation protection, and the life support system for animals aboard the spacecraft. K.W.

N67-15703*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

MICROBIOLOGICAL SURVEY OF ENVIRONMENTALLY CONTROLLED AREAS

W. W. Paik, M. R. Christensen, and J. A. Stern *In its* Space Programs Sum. No. 37–41, Vol. IV 31 Oct. 1966 p 7–16 refs

(See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

This report presents a comprehensive review of all work to determine the microbial populations present within environmentally controlled areas. Emphasis is placed on a sampling program conducted in the JPL facilities that includes assembly and sterilization, spacecraft assembly, structural test facilities, and industrial clean rooms. Levels of microbial contamination in conventional and laminar flow clean rooms were obtained from incubated air samples, surface sampling, and assay methods. Results demonstrated a correlation between the level of airborne microbial contamination and (1) the number of personnel in the area, (2) their activity level, (3) their clothing restrictions, and (4) the degree of environmental control imposed upon the personnel and the work area. G.G.

N67-15734*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FLUOROMETRIC DETERMINATION OF NUCLEIC ACIDS. I. DEOXYRIBOSE ASSAY OF BIOLOGICAL MATERIAL
J. H. Rho and J. R. Thompson *In its* Space Programs Sum. No. 37-41, Vol. IV 31 Oct. 1966 p 170–173 refs (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

In the investigation of extraterrestrial life, essential biological compounds in soil samples were studied. A fluorometric determinatio., of deoxyribonucleic acid (DNA) was applied to the estimation of a bacterial population and of DNA in soil microorganisms. Fluorescent reaction products from 3,5-diaminobenzoic acid in 4 N HCl and deoxyribose were measured in the procedure described. Applied to pure DNA and *E. coli*, the method yielded values in close agreement with those based on calculation and permits the determination of as little as 10^5 cells of *E. coli* and the microbial population in 5 to 25 mg of sandy desert soil samples. R.Ll.

N67-15809*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SOIL STUDIES—DESERT MICROFLORA. IDENTIFICATION OF SOME ALGAE FROM ANTARCTICA
R. E. Cameron *In its* Space Programs Sum. No. 37-40, Vol. 4 31 Aug. 1966 p 123–133 refs (See N67-15781 06-34) CFSTI: HC $3.00/MF $0.65

Information on the algal flora of the Antarctic continent, especially with regard to examination and identification of previously unreported algal specimens is presented. Antarctic algae are described, and compared with other desert algae. A table is included of typical population and communities of algae in the samples chosen for additional study. The most frequently observed algae were filamentous blue-greens. Most of the Antarctic algae are mesophilic or hydrophilic species. Protective mechanisms were observed in some algae which are also found in other desert algae. N.E.N.

N67-15883*# San Francisco Univ., Calif. Inst. of Chemical Biology.
BRAIN AMINO ACIDS AND BIOGENIC AMINES UNDER VARIOUS ATMOSPHERIC MIXTURES Semiannual Report, May–31 Oct. 1966
Arthur Furst 12 Dec. 1966 20 p
(Grant NGR-05-029-001)
(NASA-CR-81238) CFSTI: HC $3.00/MF $0.65 CSCL 06A

The possible environmental effects upon brain biochemistry were investigated by exposing rats to various gaseous atmospheric mixtures and measuring the free amino acid pool and biogenic amine content. Details are presented on an improved exposure chamber which exposes 5 to 10,400-gm rats at near 1 atm for periods up to 35 hr. From brain tissue analyses, at least 37 separate ninhydrin-positive compounds were detected and measured, and are tabulated. Exposure to 100% O_2 for 18 hr appeared to reduce the concentration of aspartic acid in brain tissue, but exposure for 72 hr seemed to increase the concentration. The same concentration changes were noted for methionine as for aspartic acid. Tyrosine concentration was reduced under both exposure conditions. Gamma-aminobutyric acid rose under the 18 hr exposure. Differences were noticed between the strains of rats. Serotonin was detected. N.E.N.

N67-15933*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
ACOUSTICALLY EVOKED POTENTIALS IN THE RAT DURING CONDITIONING
Robert D. Hall and Roger Greenwood Mark 30 Nov. 1966 86 p refs
(Grant NsG-496; Contract DA-36-039-AMC-03200(E); Grants NSF GK-835; NIH G-MH-04737-06)
(NASA-CR-81247; TR-455) CSCL 06C

Acoustically evoked potentials were recorded from unanesthetized rats in a series of experiments designed to study changes in sensory evoked potentials during conditioning. It is shown that when clicks are established as conditional stimuli (CS) in conditioned emotional response (CER) situations, click-evoked potentials recorded from central auditory structures and from mesencephalic reticular formation exhibit appreciable amplitude increases. Similar increases were found with Sidman avoidance conditioning. These alterations in click-evoked potentials were shown to be independent of movement or movement-related variables. Potentials evoked in central auditory structures by electrical stimuli applied to the cochlear nucleus or within the cochlea also revealed increases in amplitude during acquisition of a CER. It is concluded that changes in sensory evoked potentials observed during conditioning are not related to what may be considered the neural substrate of conditioning, but, in aversive conditioning situations at least, they are associated with fear elicited initially as an unconditioned response to noxious stimulation and later as a conditioned response. Author

N67-15941*# California Univ., Berkeley. Lawrence Radiation Lab.
[STUDIES OF HEAVILY IONIZING PARTICLES AND SPACE BIOLOGY] Semiannual Report
Tove Neville and John H. Lawrence, ed. 1966 161 p refs
(NASA Order R-104(2)09-019-900; Contract W-7405-ENG-48)
(NASA-CR-81246; UCRL-16898) CFSTI: HC $3.00/MF $0.65 CSCL 06E

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N67-15942*# California Univ., Berkeley. Lawrence Radiation Lab.
ENDOGENOUS PRODUCTION OF ^{14}CO: AND *IN VIVO* TECHNIQUE FOR THE STUDY OF HEME CATABOLISM
Stephen A. Landaw and H. Saul Winchell *In its* [Studies of Heavily Ionizing Particles and Space Biol.] 1966 p 1–10 refs (See N67-15941 06-04) CFSTI: HC $3.00/MF $0.65

A method is presented for the separation, detection, and quantitation of endogenously produced carbon-14-labelled carbon monoxide in the rat, following injection of glycine-2-^{14}C. In this method respiratory $^{14}CO_2$, the only significant breath contaminant, is removed with a sodalime absorber. The remaining breath activity, due primarily, if not entirely, to ^{14}CO, is oxidized to $^{14}CO_2$ by Hopcalite, absorbed in an ethanolamine-containing solution, and counted by liquid scintillation. Standard ^{14}CO and $^{14}CO_2$ gases, as well as animal experimentation, confirm this method's ability to measure ^{14}CO and $^{14}CO_2$ production rates simultaneously, following a single injection of labelled glycine. Examples are given to show that this continuous, in vivo, and easily performed method can give important information containing heme catabolism. The technique should provide a unique source of information in the study of disease processes characterized by abnormal heme catabolism in man and other animals. Author

N67-15943*# California Univ., Berkeley. Lawrence Radiation Lab.
A SIGNIFICANT DIFFERENCE IN MAMMALIAN-CELL POLYPLOIDY INDUCTION BETWEEN PLATEAU AND "STAR" REGIONS OF A NEGATIVE PION BEAM
William D. Loughman, H. Saul Winchell, Mudundi R. Raju and John H. Lawrence *In its* [Studies of Heavily Ionizing Particles and Space Biol.] 1966 p 11–13 refs (See N67-15941 06-04) CFSTI: HC $3.00/MF $0.65

In the experiment, mice with the A-2 lymphoma as an ascites tumor were irradiated in a negative pion beam from the 184-inch cyclotron. Mice in the plateau portion of the beam (about 60% pions) received an average dose of about 230 rads; those in the peak region (30% to 40% pions) received about 350 rads. Ascites cells were removed from the mice and prepared for chromosome examination on the third and fourth days following irradiation; 4000 metaphase cells from each mouse were scored as essentially diploid or polyploid. The summarized results are graphically depicted, and it is shown that the incidence of polyploidy among irradiated cells increased over the control values. It is also reported that additional mammalian cell experiments with negative pion beams were performed, and that survival of mice given irradiated lymphoma cells increased over control values. All experiments indicate that negative pions in the peak (star) region of the beam have a higher relative biological effectiveness than those in the plateau region. M.G.J.

N67-15944*# California Univ., Berkeley. Lawrence Radiation Lab.
BIOLOGICAL SPECIALIZATION IN MEGAKARYOCYTES AND PLATELETS
Jean-Michel Paulus *In its* [Studies of Heavily Ionizing Particles and Space Biol.] p 14–21 refs (See N67-15941 06-04) CFSTI: HC $3.00/MF $0.65

In considering the properties of megakaryocytes and platelets, comparisons are made with the physiological activities of five cellular types: a polypoloid cell, a glandular cell, an enucleate element, an endocytic cell, and a muscular cell. An extensive list of references is included, and biochemical and cytological analyses are recommended to elucidate some of the problems raised by this giant, multifunctional cell. M.G.J.

N67-15945*# California Univ., Berkeley. Lawrence Radiation Lab.
THE EFFECT OF ERYTHROPOIETIN ON THE GROWTH AND DEVELOPMENT OF SPLEEN COLONY-FORMING CELLS
John C. Schooley *In its* [Studies of Heavily Ionizing Particles and Space Biol.] 1966 p 22–41 refs (See N67-15941 06-04) CFSTI: HC $3.00/MF $0.65

The progressive growth and development of spleen colonies were studied in most animals, in which erythropoiesis was modified by such procedures as the production of polycythemia, the injection of immune serum capable of neutralizing the biological activity of erythropoietin, or the injection of exogenous erythropoietin. The findings indicate: (1) The development of erythroid colonies in the spleens of lethally irradiated mice following bone marrow transplantation was suppressed by the production of polycythemia or the injection of antibody against erythropoietin into the host mice. (2) The overall doubling time of colony-forming cells in the spleens of polycythemic mice was not altered by the injection of exogenous erythropoietin during the first 10 days after bone marrow transplantation. It is suggested that erythropoietin does not act on the colony-forming cell directly, but upon some erythropoietin sensitive cell derived from the colony-forming cell. M.G.J.

N67-15946*# California Univ., Berkeley. Lawrence Radiation Lab.
INFLUENCE OF SEVERE HYPOXIA ON HUMAN ERYTHROPOIETIN
William E. Siri *In its* [Studies of Heavily Ionizing Particles and Space Biol.] 1966 p 42–52 refs (See N67-15941 06-04) CFSTI: HC $3.00/MF $0.65

The influence of hypoxia on the regulation of red cell volume was investigated in human subjects exposed to oxygen partial pressures ranging from 160 mm Hg sea level) to 69 mm Hg (21,500 ft). Plasma-iron turnover, blood volume, and the ordinary hematological quantities were measured in Andeans residing at 12,500 to 17,000 ft; and in climbers at sea level, at 17,800 ft, and at 21,500 ft during an ascent of Mt. Everest. The results are assessed, and it was concluded that the findings bear out previous observations that healthy persons acclimatized to moderate altitudes (less than 15,000 ft) do not normally exhibit leucocytosis nor thrombocytosis, although temporary leucocytosis has been observed in the early stages of acclimization. No meaningful changes in either total or differential leucocyte counts were seen during extended exposure to high altitude. M.G.J.

N67-15947*# California Univ., Berkeley. Lawrence Radiation Lab.
STUDIES ON THE THYMUS AND THE RECIRCULATING LYMPHOCYTE POOL
John C. Schooley and Marvin M. Shrewsbury *In its* [Studies of Heavily Ionizing Particles and Space Biol.] 1966 p 53–63 refs (See N67-15941 06-04) CFSTI: HC $3.00/MF $0.65

Experiments were conducted to determine the temporal relationships between thymectomy and the first indication of a

depression in thoracic duct lymphocyte outputs. The effects of transplantation of thymic tissue on the thoracic duct lymphocyte outputs were also studied, along with the effect of altering the total recirculating lymphocyte pool using the parabiosis technique. The results show: (1) A marked decrease in the recirculating pool of lymphocytes, as measured by the hourly output of lymphocytes from the thoracic duct, occurs within a week after thymectomy. This decrease was prevented if the thymectomized animal contained a subcutaneous thymic transplant or was joined by parabiosis to an animal containing a normal thymus. This indicates that the thymus is intimately concerned in the regulation of a considerable portion of the recirculating lymphocyte pool. (2) The failure of multiple thymic transplants to elevate either the blood lymphocyte level or the output of lymphocytes from the thoracic duct suggests that some homeostatic mechanism regulates the level of thymus derived or thymus controlled lymphocytes in the recirculating lymphocyte pool. M.G.J.

N67-15948*# California Univ., Berkeley. Lawrence Radiation Lab.
SERUM-LIPOPROTEIN DISTRIBUTION AND PROTEIN ANALYSIS BY REFRACTOMETRY
Frank T. Lindgren, Norman K. Freeman, Robert D. Wills, Alicia M. Ewing, and Lin C. Jensen *In its* [Studies of Heavily Ionizing Particles and Space Biol.] 1966 p 64-74 refs (See N67-15941 06-04) CFSTI: HC $3.00/MF $0.65

Potential relationships are considered between the serum-lipoprotein distribution and the serum proteins. The measurement of serum proteins by refractometry is discussed, and the mean values and standard deviations of serum protein concentrations determined from refractometric data are tabulated together with calculations from other formulas. The relationship between specific refractive increment of serum proteins and lipoprotein classes and the refractive index of the reference media are plotted. A figure is included to show all the components measured by serum refractometry, together with the mean refractive increment values and their standard deviations for the group tested. It is apparent that neither the total serum proteins (excluding the known lipoproteins) nor total real protein can be measured accurately by serum refractometry unless the total content of serum lipoproteins is considered. It is concluded that in order to use serum refractometry to measure accurately the total serum protein macromolecules exclusive of the lipoproteins, it is necessary to measure or estimate the serum-lipoprotein spectra. M.G.J.

N67-15949*# California Univ., Berkeley. Lawrence Radiation Lab.
STUDIES ON DEFICIENT MAMMALIAN CELLS ISOLATED FROM X-IRRADIATION CULTURES
Paul W. Todd *In its* [Studies of Heavily Ionizing Particles and Space Biol.] 1966 p 72-81 refs (See N67-15941 06-04) CFSTI: HC $3.00/MF $0.65

In the experiments, the cultured mammalian cells used were human kidney line T1, and Chinese hamster bone marrow M3-1 cells. Lines of deficient cells were obtained by selecting cells from small aberrant colonies that appeared in cultures which received 500 rads of X-radiation. Based on the results, it was concluded: (1) Colonies of deficient cells appear in X-irradiated cultures of both human and hamster cells. (2) High linear energy transfer radiation is more effective than X-radiation in producing deficient cells, by the criterion of small colony development. (3) Deficient cells are respiratory deficient only to the extent that they consume less oxygen than do normal cells. (4) Hamster cells do not express their inherited deficiencies visibly in their karyotypes. However, this does not mean that heritable chromosome abberations cannot result in cellular deficiencies of the type described. M.G.J.

N67-15951*# California Univ., Berkeley. Lawrence Radiation Lab.
SECONDARY-ELECTRON DISTRIBUTION FOR HEAVY IONS
Nobuo Oda and John T. Lyman *In its* [Studies of Heavily Ionizing Particles and Space Biol.] 1966 p 87-96 refs (See N67-15941 06-04) CFSTI: HC $3.00/MF $0.65

Target theory and delta ray correction are discussed, and an experiment is described to measure the absolute yield and the slowing-down spectrum of secondary electrons with energies below 50 eV. The energy spectra for Al foil bombarded with ^4He ions, and graphs of the total yield of electrons from a Ni foil are shown. It was found that: (1) when the velocities of the primary ions are the same, the yields for each kind of ion are proportional to the total LET's, and (2) when the velocities are different, the yield for higher velocity is higher than that for lower velocity. N.E.N.

N67-15952*# California Univ., Berkeley. Lawrence Radiation Lab.
THE INTERPRETATION OF MICROBIAL INACTIVATION AND RECOVERY PHENOMENA
Robert H. Haynes *In its* [Studies of Heavily Ionizing Particles and Space Biol.] 1966 p 97-116 refs (See N67-15941 06-04) (Grant NIH GM-12667)
CFSTI: HC $3.00/MF $0.65

Developments in molecular radiation biology are outlined, and the possibility of using classical target theory to provide new mathematical interpretations of radiation survival curves is discussed. The importance of DNA as a target for inactivation by X-rays, ultraviolet light, and nitrogen mustard is emphasized. The primary findings are summarized: (1) Reproductive death in bacteria treated with radiation arises primarily from the formation of structural defects in DNA serving to block normal DNA replication. (2) Sensitization by interference is involved in the existence of shoulders on survival curves, the synergistic interactions among the radiations, and radiosensitization by agents that bind or are incorporated into DNA. (3) Repair of UV damage in Escherichia coli B/r is a multistep process involving nuclease excision of defective single-stand segments containing pyrimidine dimers, and a nonconservative mode of DNA replication which fills in the resulting gaps. N.E.N.

N67-15953*# California Univ., Berkeley. Lawrence Radiation Lab.
INACTIVATION OF PHAGE α BY SINGLE-STRAND BREAKAGE
David Freifelder *In its* [Studies of Heavily Ionizing Particles and Space Biol.] 1966 p 117-122 refs (See N67-15941 06-04) CFSTI: HC $3.00/MF $0.65

Details are presented on the experimental study of phage α inactivation, using a clear mutant of phage α propagated on *B. megaterium*, Parigi. Double stranded DNA was isolated by heating the phage for 5 min at 70°C, and identical results were obtained for both irradiated and unirradiated DNA under conditions of extended heating or denaturation. It was determined that 33% of the single stands are broken for phage α. The results of the inactivation and single-strand breakage rates are graphed. It is concluded that the *B. megaterium* phage α is more sensitive to X-ray irradiation than a typical phage of its size containing double-stranded DNA, and that the inactivating event is considered to be a single-strand break. N.E.N.

N67-15954*# California Univ., Berkeley. Lawrence Radiation Lab.
REPLICATION OF DNA DURING F'LAC TRANSFER
David Freifelder *In its* [Studies of Heavily Ionizing Particles and Space Biol.] 1966 p 123-127 refs (See N67-15941 06-04) CFSTI: HC $3.00/MF $0.65

Experiments are described in which a thymine-requiring male bacterium *Escherichia coli* transfers F'Lac in a medium containing 5-bromouracil deoxyriboside (BUDR) instead of thymine, and the presence of BUDR in the transferred DNA is detected by virtue of its sensitization to the effects of short or long wavelength

ultraviolet irradiation. The results of ultraviolet and visible light irradiation are graphed and discussed. It is concluded that when male cells containing F'Lac are mated with female cells, the transferred F'Lac is replicated either prior to or during the transfer process. N.E.N.

N67-15955*# California Univ., Berkeley. Lawrence Radiation Lab.
PLEIOTROPY AND POLYMORPHISM
Jack Lester King *In its* [Studies of Heavily Ionizing Particles and Space Biol.] 1966 p 128–129 refs (See N67-15941 06-04) CFSTI: HC $3.00/MF $0.65

A simple model is presented which demonstrates the interaction of pleiotropy and stabilizing selection, and it is suggested that pleiotropy is a potential factor toward the maintenance of genetic diversity. Selection is against double homozygotes only, and at the most favorable gene frequencies, double homozygosis occurs in as few as 25% of all zygotes. N.E.N.

N67-15956*# California Univ., Berkeley. Lawrence Radiation Lab.
INCREASE IN PLASMA GROWTH-HORMONE LEVEL IN THE MONKEY FOLLOWING THE ADMINISTRATION OF SHEEP HYPOTHALAMIC EXTRACTS
Joseph F. Garcia and Irving I. Geschwind *In its* [Studies of Heavily Ionizing Particles and Space Biol.] 1966 p 130–136 refs (See N67-15941 06-04) CFSTI: HC $3.00/MF $0.65

Experimental procedures used in studies of the radioimmunoassay of the growth hormone (GH) are presented. Plasma GH concentrations were determined in anesthetized Rhesus monkeys following insulin hypoglycemia and sheep hypothalamic tissue injections. The plasma GH level was observed to rise approximately 40 min after the insulin hypoglycemia injection, reaching the peak in at about one hour. After the administration of hypothalamic extract, the plasma GH level began to rise between 20 and 30 min, reached peak values between 45 and 60 min, and then decreased abruptly. No fall in plasma glucose was observed. It is concluded that the results support the concept that the secretion of anterior pituitary GH is mediated by a hypothalamic neurohumoral factor. N.E.N.

N67-15978# Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.
AN EXPLORATORY STUDY OF THE EFFECTS OF A HYPERBARIC ENVIRONMENT ON THE CHIMPANZEE Technical Report, 28 Nov.–11 Dec. 1965
Alfred G. Koestler and Phillip W. Day Sep. 1966 57 p refs
(ARL-TR-66-17; AD-640870) CFSTI: HC $3.00/MF $0.65

Two chimpanzees used in six separate tests were exposed to hyperbaric conditions equivalent to 50, 200, and 300 feet of seawater. Pressures were accomplished with compressed air in a dry compression chamber. Both subjects accomplished the dives without apparent physiological damage. Behavioral tasks showed small temporary decrements during extreme pressures, particularly in auditory reaction times. No symptoms of dysbarism or inert gas narcosis were evident. The use of the chimpanzee as a precursor to man in high-pressure research is recommended. Author (TAB)

N67-16026*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
EXPERIMENT M-5, BIOASSAYS OF BODY FLUIDS
Lawrence F. Dietlein and Elliott S. Harris *In* NASA. Washington Manned Space-Flight Expt., Gemini IX Mission 1 Nov. 1966 p 43–54 (See N67-16021 06-30) CFSTI: HC $3.00/MF $0.65

The M-5 experimental measurements were made to determine the metabolic cost of manned space flight by the analysis of biological fluids. Results of the analyses were used as an indication of crewman physiological status. Where changes were found to occur, efforts were made to elucidate the mechanisms producing these changes and to assess their significance relative to space flight. Author

N67-16092*# Naval School of Aviation Medicine, Pensacola, Fla. Naval Aviation Medical Center.
A COMPARISON OF OCULAR COUNTERROLLING MOVEMENTS BETWEEN NORMAL PERSONS AND DEAF SUBJECTS WITH BILATERAL LABYRINTHINE DEFECTS
Earl F. Miller, II and Ashton Graybiel 18 Feb. 1962 13 p refs Sponsored by the Office of Life Sci. Programs Joint report with NASA *Its* Rept.-68
(NASA Order R-47)
(NASA-CR-81264) CSCL 06P

The reliability and validity of counterrolling as a functional test of the otolith organs were investigated by comparing measurements obtained from a group of healthy persons with those from a group of subjects with labyrinthine defects (L-D subjects). The photographic technique used is described, and the results are presented in tabular form. Measurements of several photographs at each body position disclosed a small but significant variation in both groups of subjects which was interpreted as instability of torsional eye position. The findings in the normal subjects revealed a characteristic pattern of counterrolling; however, the results from the L-D subjects did not disclose the characteristic pattern found in normal subjects in most instances. It was felt that the highly significant group differences must have been due to loss of function of the auricular sensory organs, and intraindividual differences in the L-D group are best explained by the presence of some residual otolith function. L.E.W.

N67-16187# Chicago Medical School, Ill.
INTERNAL BODY MOVEMENT ALONG THREE AXES RESULTING FROM EXTERNALLY APPLIED SINUSOIDAL FORCES Final Report, 31 May–30 Nov. 1963
John L. Nickerson and Milana Drazic Wright-Patterson AFB, Ohio, AMRL Jul. 1966 19 p refs
(Contract AF 33(657)-10748)
(AMRL-TR-66-102; AD-641135) CFSTI: HC $3.00/MF $0.65

The report presents the results of observations on the resonance frequency and damping of a number of internal visceral body structures determined when the whole body is exposed to vibrations along three axes of the body. The X-ray method used is a modification of the system developed earlier. The results, using anesthetized dogs, are as follows. Along the long axis of the body, (Z), the resonance frequency and damping are the average respectively 4.4 cycles per second and 0.29 of the critical value. However, on axes at right angles to the long axis of the body, i.e., the transverse axis, (Y), and the dorso-ventral axis, (X), the values are respectively 9.1 and 8.9 cycles per second for the resonant frequency and 0.35 and 0.37 for the damping factor along the corresponding axes. Author (TAB)

N67-16201# Stanford Univ., Calif. Inst. for Mathematical Studies in the Social Sciences.
LEARNING AND SHORT-TERM RETENTION OF PAIRED ASSOCIATES IN RELATION TO SPECIFIC SEQUENCES OF INTERPRESENTATION INTERVALS
Robert A. Bjork 11 Aug. 1966 75 p refs
(Contract Nonr-225(73); Grant NIH G-MH-6154)
(TR-106; AD-641395) CFSTI: HC $3.00/MF $0.65

The dissertation reports a study of short-term retention in paired-associate list learning. One purpose of the study was to ascertain empirically the extent to which short-term memory influences performance during the acquisition of a list of paired associates; a second was to gather evidence with respect to the conceptual relationship of short-term memory and learning. The

particular experimental behavior chosen for study was the learning of a list of paired associates by means of a series of anticipation trials. An anticipation trial starts with the presentation of a stimulus to which the subject attempts to anticipate the correct response and ends with a presentation of the correct response. During an experimental session, the trials on any one item (presentation sequence) are characterized by a sequence of interpresentation intervals; that is, any two successive presentations of an item are separated by some number of trials on other items. The experimental design modified the standard anticipation procedure in two ways. (1) The series of trials was generated by a computer-implemented algorithm designed to yield a uniform distribution of interpresentation intervals. (2) All subjects had the same series of trials in the sense that each had the same set of presentation sequences. The confounding of item differences with the effects of the presentation sequences was avoided by counterbalancing across subjects the assignment of items to presentation sequences. Author (TAB)

N67-16275# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

Sr-90 IN HUMAN-BONES IN POLAND—RESULTS FOR 1960 AND 1961

J. Liniecki and W. Karniewicz *In its* Nukloenika, Vol. VIII 1966 p 373-382 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The concentrations of Sr-90 per gram of calcium in human bones in Poland over the period from 1960 through 1961 are presented. The peak value in 1960 occurred in bones of ab. 2.5 years old children and amounted to 3.3 pc/gCa. In 1961 the highest mean concentration of Sr-90—2.6 pc/gCa—was found in children ab. 1.5 years old. The concentration of Sr 90 per gram calcium in bones of adults did not vary with age above 30 years and mean values in vertebral bodies in 1960 and 1961 were respectively 1.00 and 1.16 pc/gCa. These values correspond to the average concentration in the skeleton of ab. 0.40 and 0.47 pc/gCa. Author

N67-16340# Naval Radiological Defense Lab., San Francisco, Calif.

EVALUATION OF RADIOPROTECTIVE ACTIVITY OR PROPERTIES OF SELECTED CHEMICAL COMPOUNDS IN LARGE ANIMALS Annual Progress Report, 1 Jul. 1965–1 Jul. 1966

L. J. Cole and E. L. Alpen 1 Jul. 1966 12 p refs

(USAMR&DC-6007; AD-642313) CFSTI: HC $3.00/MF $0.65

The objective of the research was to investigate and evaluate the radioprotective activity and properties of selected chemical compounds in large animals, and to gain insights into their mechanism of action. With respect to chemical radioprotection efforts were directed toward three general areas: (a) Studies on Compound WR-1607 in lethally X-irradiated dogs (beagles as well as mongrels) and the possibilities of combinations of other compounds with WR-1607; (b) The protective effect of small external lead cuffs, alone or in combination with chemicals, in dogs; and (c) Studies on chemical radio-protection in mice, employing hemopoietic colony-forming units (CFU) as the endpoint. Author (TAB)

N67-16345# Harvard Univ., Cambridge, Mass. Group Psychology Branch.

OPERANT ELECTRODERMAL CONDITIONING: SOME EFFECTS OF MULTIPLE SCHEDULES OF REINFORCEMENT

David Shapiro and Andrew Crider Nov. 1966 13 p refs

(Contract Nonr-1866(43))

(TR-14; AD-641699) CFSTI: HC $3.00/MF $0.65

The rate of emission of palmar skin potential responses in human subjects can be brought under the control of external stimuli correlated with different schedules of operant reinforcement. Successful discriminations are formed between reinforcement and nonreinforcement conditions, and differential rates of response are observed by alternating the scheduling of intermittent reinforcement. Author (TAB)

N67-16346# Brooke Army Medical Center, Ft. Sam Houston, Tex.

RESEARCH PROJECT: CHROMOSOMA (DAMAGE IN HUMANS PRODUCED BY X-IRRADIATION Annual Progress Report

Jose M. Louro [1966] 21 p refs

(AD-641505) CFSTI: HC $3.00/MF $0.65

The chromosomes of peripheral leucocytes in subjects exposed to more than 2500 R of x-irradiation were compared with those of normal, healthy individuals and several other subjects not exposed to x-irradiation. The results revealed that in the irradiated group there was a marked increase in aneuploidy, polyploidy, endoreduplication and structural chromosomal damage. Author (TAB)

N67-16348# Army Biological Labs., Fort Detrick, Md.

THE USE OF ACRIDINE ORANGE LUMINESCENCE FOR THE STUDY OF THE SECONDARY STRUCTURE OF NUCLEIC ACIDS

O. F. Borisova and L. A. Tumerman Jul. 1965 15 p refs Transl. into ENGLISH from Biofiz. (USSR), v. 10, no. 1, 1965, p 32-36

(TRANS-1483; TT-65-63435; AD-639797) CFSTI: HC $3.00/MF $0.65

Translation of Russian research: the use of acridine orange luminescence for the study of the secondary structure of nucleic acids. Author (TAB)

N67-16360# School of Aerospace Medicine, Brooks AFB, Tex.

THRESHOLD DISTANCES FOR RETINAL BURNS FROM LOW-YIELD NUCLEAR DETONATIONS

Everett O. Richey Jul. 1966 16 p refs

(SAM-TR-66-49; AD-641188) CFSTI: HC $3.00/MF $0.65

A method is given for predicting the threshold distances at which minimal retinal burns will be produced by nuclear detonations. This method relates calculated retinal exposure to experimentally determined burn threshold data. Predicted threshold distances are determined for the human eye exposed to sea-level, air-burst detonations from 0.01 to 10 kt. yield. The pupil diameter of the human eye is taken to be 2.5 mm. and 6.0 mm., respectively, for day and night conditions, and the effective focal length of the eye is taken to be 17 mm. The threshold distance for a bright daylight exposure with clear air (80 km.) visibility varies from about 1.3 to 11 km. as the detonation yield varies from 0.01 to 10 kt. Comparable distances for night exposures vary from 3.8 to 26 km. Calculations indicate that the use of a fixed filter with 2% transmission will result in retinal exposures more than an order of magnitude below the threshold exposure for these small daylight detonations. For nighttime conditions the retinal exposure is a factor of about 2.5 below the threshold exposure. Author (TAB)

N67-16365# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.

WATER RECOVERY FROM HUMAN WASTE DURING PROLONGED CONFINEMENT IN THE LIFE SUPPORT SYSTEM EVALUATOR Technical Report, Jul. 1964–Jun. 1965

Courtney A. Metzger, Albert B. Hearld, and Bobby G. McMullen Apr. 1966 33 p refs

(AMRL-TR-65-170; AD-642053) CFSTI: HC $3.00/MF $0.65

The recovery of water from urine and/or atmospheric condensate was carried out. Each experiment included the

confinement of 4 subjects inside the aerospace medical research laboratories life support systems evaluator for a period of 4 weeks. The reclamation equipment included a thermoelectric distillation device, an electro dialysis unit and a dehumidification system. The water recovered was analyzed to determine its suitability for human consumption. Author (TAB)

N67-16417# School of Aerospace Medicine, Brooks AFB, Tex. Aerospace Medical Div.

VIRAL ANTIBODY PRODUCTION IN ANIMALS EXPOSED TO A SPACE CABIN ENVIRONMENT Progress Report, Jul.–Sep. 1965

David J. Giron and Jerome P. Schmidt Sep. 1966 11 p refs
(SAM-TR-66-82; AD-641566) CFSTI: HC $3.00/MF $0.65

Synthesis of antibody against vaccinia virus was investigated in rabbits exposed to a simulated space cabin environment. The atmospheric pressure in the cabin was equivalent to an altitude of 18,000 feet; the partial pressure of oxygen was approximately that of sea level. The animals were acclimatized for 7 days and then immunized with a series of injections of purified vaccinia virus over a period of 5 weeks. Control animals remained at ground level and received identical injections from the same virus pool. Specific antibody produced by each group was tested for its neutralization titer and distribution of specific activity in fractions separated by column chromatography and sucrose gradients. No qualitative or quantitative differences in antibody produced were noted. Author (TAB)

N67-16424# Naval Submarine Medical Center, Groton, Conn.

THE EFFECT OF FREQUENCY PASSBAND UPON THE INTELLIGIBILITY OF HELIUM-SPEECH IN NOISE Interim Report

Russell L. Sergeant 17 Aug. 1966 13 p refs
(Rept.-480; AD-641960) CFSTI: HC $3.00/MF $0.65

Speech spoken after breathing a mixture of helium and oxygen (80%–20%) was combined with white noise and then passed through a variety of bandpass filters. Intelligibility was determined on 16 different groups of 20 listeners each. While intelligibility did not suffer appreciably when frequencies of 300 cs and below were eliminated, the loss of frequencies below 600 cs caused a marked deterioration. Even with severe filtering restrictions of a 600-1200 cs bandpass and a 1-db Speech/Noise ratio, 38% intelligibility was achieved. This indicates that the intelligibility of speech in a helium mixture, as in air, is quite distortion-resistant. The frequency at which high- and low-pass filtering will have equal effects on intelligibility appears to be lower than 1000, in contrast to approximately 1600 cs for speech in air. Reasons for this downward shift are not known. No condition of filtering helium-speech in noise increased its intelligibility. Author (TAB)

N67-16430# Columbia Univ., New York. Teachers Coll.

TECHNIQUES OF INDUCING COOPERATION BETWEEN ADVERSARIES Annual Status Report

Morton Deutsch Oct. 1966 15 p
(Contract Nonr-4294(00))
(AD-642423) CFSTI: HC $3.00/MF $0.65

Summaries are presented of the following studies: Use of Role-Reversal in Intergroup Competition; Further Research with the Prisoners Dilemma; Strategies of Inducing Cooperation; The International Card game study; Compliance to Threats Directed Against Self and Against an Innocent Third Person. TAB

N67-16434# Centre d'Enseignement et de Recherches des Industries Alimentaires et Chimiques, Brussels (Belgium).

REGULATION OF RNA SYNTHESIS Final Scientific Report

R. Lavalle 30 Sep. 1966 21 p ref
(Grant AF-EOAR-65-16)
(AFOSR-66-2650; AD-642385) CFSTI: HC $3.00/MF $0.65

Measurements of rRNA and tRNA content of E.Coli Ki2 cells have been made in the following situations: (a) exponential growth in media giving rise to different growth rates; (b) shift up from mineral to rich (in amino acids) medium; (c) starvation of a relaxed mutant; (d) chloramphenicol treatment; (e) shift down from rich to mineral medium. The conclusions are that (1) the stringent control, which acts during an amino acid starvation, works on both rRNA and tRNA; and (2) the control mechanism involved in the regulation of RNA content versus chemical environment works differentially on both species. A mutant with a peculiar behavior during a shift up experiment is described, and a new relaxed mutation is described. Author (TAB)

N67-16438# Army Biological Labs., Fort Detrick, Md.

EFFECT OF PLAGUE TOXIN ON BLOOD PROTEINS AND INCORPORATION OF METHIONINE-S^{35} INTO TISSUE PROTEINS

I. V. Domaradskiy, I. M. Klimova, and A. A. Tokareva Dec. 1965 13 p refs Transl. into ENGLISH from Vopr. Med. Khim (Moscow), v. 7, Nov.–Dec. 1961 p 614–619
(TRANS-1712; TT-66-62550; AD-641427) CFSTI: HC $3.00/MF $0.65

In white mice plague microbe toxin disrupts the ratio between the protein fractions of the blood serum. There is a decrease in the content of albumins and an increase in the concentration of globulins. However, it is difficult to say due to which fraction of globulins the lowering of the albumin-globulin coefficient takes place. The stated changes have a stable nature and are detected in surviving animals even after 3 days following the administration of toxin to them. During plague intoxication the total amount of protein is not changed. The influence of the toxin on the blood serum proteins of guinea pigs is doubtful. Plague intoxication changes the rate of incorporation of Methionine-S35 into the blood proteins of white mice and does not influence the rate of incorporation of methionine-S35 into the blood proteins of guinea pigs and the tissue proteins of both species of animals. Author (TAB)

N67-16451# Technology, Inc., San Antonio, Tex.

RESEARCH TOWARD THE DEVELOPMENT OF EYE EFFECTS SAFE SEPARATION CHARTS Final Report, 31 May 1965–31 May 1966

Arthur F. Muller and Patrick W. Wilson, Jr. Brooks AFB, Tex., Aerospace Med. Div., Jul. 1966 89 p refs
(Contract AF 41(609)-2437)
(AD-641191) CFSTI: HC $3.00/MF $0.65

The purpose of this report is to make known the research methods, results, and conclusions involved in a study which was to develop eye safe separation distances from nuclear detonations in terms of yield, altitude, slant range, etc. Under the precept that retinal temperature is the most significant factor in ocular damage, a mathematical model for the prediction of retinal temperature is outlined. Theoretical and empirical fireball source data are input separately to the model in an effort to determine the applicability of the theoretical data by comparing calculated retinal temperature rise. The results of the comparisons are favorable. However, it is concluded that, presently, the model retinal temperature predictions must be used with reservation. Author (TAB)

N67-16475# Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.

A CIRCADIAN TEMPERATURE RHYTHM IN THE RHESUS MONKEY

Joseph W. Ternes and Donald W. Farrer Nov. 1966 21 p refs
(ARL-TR-66-21; AD-643328) CFSTI: HC $3.00/MF $0.65

A rhesus monkey was restrained and kept isolated from normal laboratory distractions for 4 months. Environmental and

subcutaneous temperatures were recorded every 15 minutes throughout this time. A circadian rhythm of subcutaneous temperature, whose frequency was synchronized to the 24 hour light–dark cycle, was demonstrated. The effects of constant illumination and of different feeding times were also studied. It was found that the subcutaneous temperature rhythm can be maintained under constant illumination and also that the shape of the daily curve, for this rhythm, can be effectively modified by manipulating feeding time. Author (TAB)

N67-16481# Illinois Univ., Urbana. Coordinated Science Lab.
A PARADIGM FOR THE INVESTIGATION OF ANTECEDENT PROCESSES IN CONCEPT ATTAINMENT
Steven Henry Schwartz Sep. 1966 102 p refs
(Contracts DA-28-043-AMC-00073(E); Nonr-3985(08); Grant NIH G-MH-06836)
(R-321; AD-641117) CFSTI: HC $3.00/MF $0.65

The purposes of the study were: (1) To examine the utility of the proposed schema for investigating behavior in concept attainment tasks by: (a) Determining the strength of the theoretical hypotheses relating the five stipulated constructs (magnitude, and scope of relations over conditions). (b) Determining the locus of effect of various independent variables (known to affect terminal performance) on the above response variables encompassed by the theoretical hypotheses. (c) Determining the locus of effect of numerous subject-determined variables (such as content--total population of instances, and sequence--order in which instances are tested) on the response variables encompassed by the theoretical hypotheses. (d) Determining the temporal and sequential orderings in behavior involving these constructs prior to attainment of the concept. (2) To explore other interesting relations manifest in the data that have not as yet been incorporated within a formal theory. (3) To compare the theory with other models at points where there exist common terms. Author (TAB)

N67-16503*# Hazleton Labs., Falls Church, Va.
A STUDY TOWARD DEVELOPMENT OF AN AUTOMATED MICROBIAL METABOLISM LABORATORY Monthly Progress Report
Earl Usdin and George R. Perez 1 Nov. 1966 53 p refs
(Contract NASw-1507)
(NASA-CR-81263; MPR-1) CFSTI: HC $3.00/MF $0.65 CSCL 06M

Development of life detection systems based on phosphate uptake and sulfur uptake is discussed together with an examination of some of the engineering problems associated with instrumentation of these experiments. These life detection systems will consist of the following metabolic experiments: metabolism of radioactive substrates, heterotrophic photosynthesis, autotrophic photosynthesis ATP production, phosphate uptake, and sulfate uptake. Conventional phosphate assays were studied as well as an assay that measures phosphate levels in terms of counts derived from ^{14}C-labeled triethylamine. In the former case, sensitivities down to 3 μ/L of phosphate-P were observed. The ultimate sensitivity has not yet been determined for the radioisotropic assay. The engineering effort was concerned with designing liquid processing systems, studying the proposed single read-out system, and tentatively investigating photomultiplier tube selection. S.P.

N67-16545*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN EXPERIMENT TO DETECT MICROORGANISMS IN THE UPPER ATMOSPHERE FLOWN ON AEROBEE NASA 4.150
Grace Lee Picciolo, E. M. Powers, and E. Rich, Jr. Dec. 1966 29 p refs
(NASA-TM-X-55642; X-624-66-359) CFSTI: HC $3.00/MF $0.65 CSCL 06C

A cosmic dust collector was modified to collect microorganisms from the atmosphere. Detection was performed on samples from the recovered collector by classical growth methods and by the firefly luciferase assay for adenosine triphosphate. These methods showed no statistically significant results to indicate the presence of microorganisms. Microbiological tests were run to determine best methods of organism removal, recovery, and assay. Sterility effectiveness was determined on the collector, the sampling film, and on procedures for removal and assay. Data are given on flight conditions, preliminary tests, assay, and sample volume. Author

N67-16554*# National Aeronautics and Space Administraton, Washington, D. C.
AEROSPACE MEDICINE AND BIOLOGY–A CONTINUING BIBLIOGRAPHY WITH INDEXES, NOVEMBER 1966
Dec. 1966 153 p refs
(NASA-SP-7011(31)) CFSTI: HC $3.00/MF $0.65 CSCL 06S

The bibliography with abstracts concentrates on the biological, physiological, psychological, and environmental effects on man during simulated or actual space flight. Similar effects on lower order organisms, and the related topics of sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors are also included. Emphasis is on applied research. N.E.N.

N67-16579*# Aeronutronic, Newport Beach, Calif.
STUDY OF THE AUTOMATED BIOLOGICAL LABORATORY PROJECT DEFINITION. VOLUME V: EXOBIOLOGY BIBLIOGRAPHY
Temple W. Neumann 10 Sep. 1965 158 p refs
(Contract NASw-1065)
(NASA-CR-81311; U-3237, Vol. V) CFSTI: HC $3.00/MF $0.65 CSCL 06C

An annotated bibliography dealing with various aspects of the problem of detecting extraterrestrial life is presented. The material is to be used with respect to the automated biological laboratory (ABL) program for exploring life on Mars. The bibliography is divided up into the following sections: (1) general analytical methods, (2) automatic techniques, (3) calorimetry, (4) carbon analysis, (5) chromatography, (6) computer applications, (7) fluorescence studies, (8) gas analysis, (9) instruments and devices, (10) life, (11) macromolecule studies, (12) Mars, (13) mass spectrometry, (14) microbiological studies, (15) optical rotation studies, (16) soil constituent analysis, (17) space probes, (18) spectrometry, and (19) synthesis of organic compounds. The references cited are mainly compiled from September 1964 to April 1965, and the majority of abstracts are those of the authors themselves. An author index is included. L.S.

N67-16580*# Aeronutronic, Newport Beach, Calif.
STUDY OF THE AUTOMATED BIOLOGICAL LABORATORY PROJECT DEFINITION. VOLUME VI: TECHNICAL APPENDICES. PART 1 Final Report, 10 Aug. 1964–10 Aug. 1965
Temple W. Neumann 10 Sep. 1965 382 p refs
(Contract NASw-1065)
(NASA-CR-81308; U-3237) CFSTI: HC $3.00/MF $0.65 CSCL 06C

Detailed technological reference material pertinent to the scientific payload definition and system engineering studies conducted for the automated biological laboratory (ABL) project, are given. A summary analysis of the interviews through which much of the information on scientific payload objectives was obtained is presented. Procedures for the 35 biological and environmental experiments selected, are given. Also described, are various analyses performed on detailed aspects of instruments used in the study. L.S.

N67-16608*# Northrop Space Labs., Hawthorne, Calif.
INVESTIGATION OF PEROGNATHUS AS AN EXPERIMENTAL ORGANISM FOR RESEARCH IN SPACE BIOLOGY Summary Progress Report, 1 Jan–31 Dec. 1966
R. G. Lindberg 31 Dec. 1966 100 p refs
(Contract NASw-812)
(NASA-CR-81351; NSL-64-29-13) CFSTI: HC $3.00/MF $0.65 CSCL 06C

Progress is reported in studies of the temperature regulation in the pocket mouse *Perognathus longimembris*. Abdominal, colonic, and subcutaneous body temperatures were measured in mice exposed to various ambient temperatures. Thermal conductance, physical insulation, and metabolic rate were measured in normothermic, torpid, and dead animals. The mice showed good thermoregulation when not torpid. Mice acclimatized to 22°–24°C showed resistance to change in body temperature when exposed to cold, heat, and continuously changing ambient temperatures. The core-to-subcutaneous temperature gradient varied with ambient temperature in a definite pattern that suggests four zones of regulation. It was found that mice entering and arousing from torpor go through several phases of temperature change. Resting metabolism was 0.53 and conductance was 0.78 of certain mammalian standards, which is consistent with a body temperature reduced below 37°C. C.T.C.

N67-16610*# National Academy of Sciences—National Research Council, Washington, D. C.
XVI INTERNATIONAL CONGRESS OF ZOOLOGY. VOLUME 5: AN ACCOUNT OF THE CONGRESS
John A. Moore, ed. 1964 175 p refs Proc. held in Washington, D. C., 20–27 Aug. 1963
(Grant NsG-364)
(NASA-CR-81349) CFSTI: HC $3.00/MF $0.65 CSCL 06C

An account of the organization, planning, and proceedings of the zoological congress is provided. Reports are included from the various planning committees such as finance, science theater, projection, excursions, public information, biological program, and zoological nomenclature. A list of congress members, suggestions for the preparation of lantern slides, and five additional abstracts of contributed papers are also given. A.G.O.

N67-16613*# Martin Co., Baltimore, Md. BIAS Div.
RESEARCH IN PHOTOSYNTHESIS Quarterly Report, Jun. 6–Sep. 6, 1966
Bessel Kok 6 Sep. 1966 38 p
(Contract NASw-747)
(NASA-CR-81345; QR-13) CFSTI: HC $3.00/MF $0.65 CSCL 06C

Emphasis was placed on the kinetics of the various reactions of dichlorophenol indophenol in illuminated chloroplasts. Experimental work on fluorescence emission included the design and operation of a multi-flash technique which allowed a direct measurement of the ratio of the pool sizes of the primary and secondary reductants of photosystem II. The number obtained agreed quite well with earlier indirect measurements and indicated a ratio of 1–20. New lines of research have been initiated: these concerned the conformational changes occurring in chloroplast particles upon illumination, chemiluminescence, and the possible role of cytochrome b. Author

N67-16648# Union Carbide Corp., Tonawanda, N. Y. Linde Div.
MECHANISMS OF FREEZING INJURY TO BIOLOGICAL SYSTEMS Final Report
G. F. Doebbler 30 Sep. 1966 94 p refs
(Contract Nonr-4788(00))
(AD-640995) CFSTI: HC $3.00/MF $0.65

Biophysical and biochemical studies were conducted on red cells, liver mitochondria, and various proteins to determine the mechanisms of freezing injury to biological systems. The working hypothesis formulated was that freezing resulted in molecular level dehydration leading to changes in proteins in terms of contractile behavior, enzymatic activity, interactions with water, and molecular size or shape. In general the evidence obtained, especially with proteins, and in particular by measurements of desorption-adsorption iso therms for water and gel chromatography showed no freeze related changes. Serum lipoproteins and frozen red cell membranes showed irreversibility in desorption-adsorption of water. Rat liver mitochondria were unaltered in contractile behavior by a variety of freezing conditions, some known to markedly alter function and permeability. Red cells (RBC) sustained cation composition changes (K decrease; Na increase) and ATPase activity increase when subjected to dehydration (without ice or increased salt exposure) which resembled that found with freezing. Kinetics of salt injury to RBCs and the dependence on temperature was found inconsistent with salt as the only agent of freezing injury. Author (TAB)

N67-16650# Lund Univ. (Sweden). Dept. of Histology.
CHOLINESTERASES IN OCULAR AND ORBITAL TISSUES OF SOME MAMMALS
Berndt Ehinger 1966 18 p refs Presented at the Royal Physiographic Soc., 2 Dec. 1965 *Its* Section II, No. 2
(Grants AF-EOAR-14-66; PHS-NB-0536-02; B66-320)
(AFOSR-66-2072; AD-643148)

Cholinesterase-containing nerves in occular and orbital tissues from rats, rabbits, and guinea-pigs were studied. In the corneal stroma, there occurred nerve bundles which contained mainly acetylcholines-terase (ache). In the corneal epithelium, fine fibres containing ache were also found. Ache-containing fibres further reached the sphincter pupillae and the dilator muscle in all species. In the chamber angle, the guinea-pig displayed many fibres containing nonspecific cholinesterase (che) only, whereas few fibres containing either ache and che were found in the chamber angle of the rat or rabbit. Ache-containing fibres occurred in the ciliary muscle of all species. Such fibres were also found in the connective tissue at the limbus, in the iris and in the choroid. The structure innervated by these fibres is unknown. In the retina, ache was found in the inner plexiform layer, and also in the ganglion cell layer of the rat. In the smooth muscles of the orbit and the eyelid, ache-containing fibres occurred, but they are considerably fewer than the adrenergic fibres. Che-containing fibres occurred to almost the same extent as do the adrenergic fibres in this muscle. Author (TAB)

N67-16653# Northwestern Univ., Evanston, Ill. Auditory Research Lab.
MONAURAL VERSUS BINAURAL DISCRIMINATION FOR FILTERED CNC MATERIALS, THE IMPAIRED AUDITORY MECHANISM, 1 May 1963–15 Dec. 1964
Tom W. Tillman, Paul C. Bucy, and Raymond Carhart Brooks AFB, Tex., School of Aerospace Med., Jul. 1966 26 p refs
(Contract AF 41(609)-2643)
(SAM-TR-66-64; AD-639639) CFSTI: HC $3.00/MF $0.65

Northwestern University Auditory Test No. 4 was altered by: (1) low-pass filtering with a 1480 cps cutoff frequency and a 54 dB per octave slope; and (2) high-pass filtering utilizing an 1830 cps cutoff frequency and a 36 dB per octave slope. By using these filtered materials, a single binaural and two monaural articulation functions were derived for each of 60 subjects with peripheral hearing losses and 7 subjects with unilateral CNS lesions judged to involve the auditory system. In the monaural conditions each subject received either the high-pass or low-pass filtered signal. In the binaural condition the two messages were presented simultaneously, one to each ear. The experimental hypothesis predicted that for the subjects with peripheral impairments, the slope of the binaural function would exceed that of the steeper monaural one. Conversely, it predicted that for the subjects with

unilateral central involvement, the binaural function would not differ in slope from the monaural functions. Results only partially confirmed this hypothesis. For both groups, the slope of the binaural function exceeded that of the steeper monaural function; however, the slope of the binaural function for the peripheral lesion group exceeded that of the CNS lesion group. Since the hearing acuity of the latter group was within normal limits, this finding indicates that in unilateral central auditory lesions, the binaural processing of speech signals is incomplete. Author (TAB)

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N67-15359# Bunker-Ramo Corp., Canoga Park, Calif.
THE UTILIZATION OF HUMAN FACTORS IN FORMATION BY DESIGNERS Technical Report, Dec. 16, 1965–Sep. 15, 1966
David Meister and Donald E. Farr 16 Sep. 1966 105 p refs
(Contract Nonr-4974-00)
(AD-642057) CFSTI: HC $3.00/MF $0.65

Three design tests were developed to determine how human factors criteria and information are applied to design problems. Each 4-hour test was administered individually to 20 designers. Test results indicate that designers have little or no interest in human factors and usually fail to apply human factors criteria to design. They do not read human factors handbooks. Design analyses appear to be quite primitive, being largely determined by spatial constraints and experiential stereotypes. Designers have difficulty in anticipating operational problems that may result from design parameters and are unable to evaluate completed designs. Design managers are somewhat more sophisticated in their design analyses than designers, but only slightly so. Both designers and human factors specialists were highly consistent in their responses. The most important source of information for the designer is the design specification. Where a designer does not have formally assigned responsibility for a design parameter, his analysis will not reflect this factor. It is recommended that design specifications emphasize human factors to the same extent that other functional requirements are emphasized. The format of handbook material directed at designers should be simplified, and contain procedures for analyzing design problems and examples of the application of information to these problems. Author (TAB)

N67-15407# Bunker-Ramo Corp., Canoga Park, Calif. Human Engineering Group.
PILOT OPINION SURVEY OF A MOVING TAPE VERNIER PITCH DISPLAY CONCEPT
Barbara J. Kelso 26 Aug. 1966 18 p
(Contract AF 33(615)-5225)
(MR-66-15; AD-640717) CFSTI: HC $3.00/MF $0.65

The report discusses the evaluation of a moving tape vernier pitch display concept. Objective of the evaluation was to elicit opinions from pilots and engineers on: (1) the potential merit of the display concept for continued development, and (2) suggestions for improving the display format. PIS (Photographic Instrument Synthesizer) films of the pitch indicator were shown, and comments were elicited through an open-ended questionnaire. The report describes the display concept, the method employed in the evaluation, results of the questionnaire, and suggested follow-on work. Author (TAB)

N67-15830*# AiResearch Mfg. Co., Los Angeles, Calif.
FULL PRESSURE SUIT HEAT BALANCE STUDIES
E. C. Wortz, R. A. Diaz, D. K. Edwards, L. E. Browne, E. J. Prescott et al Feb. 1965 226 p refs
(Contract NAS9-2886)
(NASA-CR-81183; LS-140) CFSTI: HC $3.00/MF $0.65 CSCL 06A

Experiments were conducted to establish a thermal balance between heat removal and metabolic rate in the pressurized Gemini G2-C full pressure suit at sea level and at 32,500 ft. The pressure suit ventilation gas inlet conditions were dew-point temperature of 33°F, flow rate of 17.1 ft^3/min with the suit pressurized to 3.7 psig over cabin ambient, and dry-bulb temperatures of 76°F at sea level and 50°F at altitude. Data are reported for 10 subjects exercising at 1.4 and 2.0 mph on a level treadmill. Conclusions are drawn concerning metabolic rates, heat storage, and the adequacy of sea level simulation. Author

N67-15850*# National Aeronautics and Space Administration, Washington, D. C.
MANUAL CONTROL
1966 422 p refs Proc. of the 2d Ann. NASA-Univ. Conf., Cambridge, Mass., 28 Feb.–2 Mar. 1966
(NASA-SP-128) GPO: HC $2.50; CFSTI: MF $0.65 CSCL 05H

Symposium papers on discrete and continuous models; adaptive, multivariable and optimal control, information theory, display, motion and stress, and analysis and design methods are presented. For individual titles See N67-15851–N67-15880.

N67-15851*# National Aeronautics and Space Administration, Washington, D. C.
SUMMARY
Lawrence R. Young and Roger Windblade (MIT) *In its* Manual Control 1966 p 1–11 (See N67-15850 06-05) GPO: HC $2.50; CFSTI: MF $0.65

Papers presented at the NASA-university program conference on manual control are summarized according to the models, control devices, performance of operators, and information theory. Emphasis in the conference was on the development of models to describe human operator behavior in detail in multiple-loop, multiaxis, time-varying or deliberately nonlinear tracking situatons. Ideas on tracking ability are applied to a variety of vehicle control tasks. The three-day meeting was attended by about 100 specialists in the field of engineering psychology. M.W.R.

N67-15852*# Michigan Univ., Ann Arbor.
SUMMARY OF SINE-WAVE TRACKING STUDIES
R. W. Pew, J. C. Duffendack, and L. K. Fensch *In* NASA. Washington Manual Control 1966 p 15–24 refs (See N67-15850 06-05) GPO: HC $2.50; CFSTI: MF $0.65

A sine-wave tracking studies illustrate the extent to which the predictability of the input and of the control device dynamics can be utilized with extended practice. Analysis of the error power spectra establishes the presence of a stable source of noise power in the operator's output that has implications for deriving models of manual tracking performance. Author

N67-15853*# University of Southern Calif., Los Angeles.
ASYNCHRONOUS FINITE STATE MODELS OF MANUAL CONTROL SYSTEMS
G. A. Bekey and E. S. Angel *In* NASA. Washington Manual Control 1966 p 25–37 refs (See N67-15850 06-05) GPO: HC $2.50; CFSTI: MF $0.65
(Grants NGR-05-018-022; AF-AFOSR-1018-66)

Mathematical models are presented based on the assumption that the operator quantizes his input and output into a limited

number of states. Data processing is performed on asynchronous samples of this coarsely quantized input, and the human operator behaves as a finite-state machine. A hybrid output element or hybrid actuator is used to achieve a continuous variation of output position. To provide for the generation of timed output waveforms in manual tracking, the concept of the hybrid actuator also provides a bridge between binary decisions and continuous time. The application of standard logical design techniques to the synthesis and minimization of the resulting mathematical models is discussed. For the particular case of compensatory control of a pure inertia plant, a human controller model can be synthesized by using only threshold gates, flip-flops, gates, and hybrid actuators. Proposed research in further applications of finite-state machine theory to manual control is discussed. Author

N67-15854*# Systems Technology, Inc., Inglewood, Calif.
SOME NEUROMUSCULAR SUBSYSTEM DYNAMICS
Duane McRuer *In* NASA, Washington Manual Control 1966 p 39–43 refs (See N67-15850 06-05) GPO: HC $2.50; CFSTI: MF $0.65
(Contracts NAS2-2824; AF 33(657)-10835)

Describing-function models are presented for the transfer dynamics for the complete human operator. A precision-type model is a minimum form compatible with both the fine-detail, low variability data for random appearing forcing functions and the dynamics of the movement components in step responses. An approximate model reduces the number of parameters used without causing serious degradation in the analytical description of the data. The same gain, equalization, and basic latency elements are exhibited by both models; although they differ in their neuromuscular system aspects. The precision model uses high frequency effects of third order; the approximate model uses low frequency approximations of either the first order, so-called neuromuscular lag, or of a pure time delay. An elementary neuromuscular system model is presented in which loop gain is the only system parameter that has to be varied to create a covariant connection between the equivalent time delay and the low frequency phase lag parameter. M.W.R.

N67-15855*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
PROCESS OF ADAPTATION BY THE HUMAN CONTROLLER
Jerome I. Elkind and Duncan C. Miller *In* NASA, Washington Manual Control 1966 p 47–63 refs (See N67-15850 06-05) GPO: HC $2.50; CFSTI: MF $0.65
(Contract AF 33(657)-10124)

A model is presented for the detection, identification, and modifications phases of the process by which the human operator adapts to changes in dynamics. The model contains (1) an internal adjustable portion for the plant dynamics, (2) a threshold detector compares change in error rate due to control movement with that predicted by the internal portion, (3) a decision tree that identifies change in dynamics by sequentially determining modifications in the internal portion that must be made for observed and predicted error rates to correspond, (4) and a switching tree that permits rapid and sequential changes in human controller characteristics. The detection and identification models accurately predict the time at which the human controller will detect a change in plant; and the dependence of identificaton time on plant change uncertainty and complexity is predicted. The mode-switching adjustment was verified by analysis of the adjustment process of well-trained controllers who exhibit very rapid changes in characteristics when they have detected a change in plant dynamics. M.W.R.

N67-15856*# Systems Technology Inc., Inglewood, Calif.
MODEL OF HUMAN-OPERATOR RESPONSE TO STEP TRANSITIONS IN CONTROLLED ELEMENT DYNAMICS
D. H. Weir and A. V. Phatak *In* NASA, Washington Manual Control 1966 p 65–83 refs (See N67-15850 06-05) GPO: HC $2.50; CFSTI: MF $0.65
(Contract NAS2-1868-4)

A critical control problem involving the vehicle/controlled-element system results from a step transition (sudden change) in the controlled element. Practical examples include failure of a manned aircraft stability augmenter, or the large changes in center of gravity which might occur during staging in the manual control of boost. Derivation of an analytical model useful in predicting operator transition response is summarized. Extensive use is made of experimental data from a variety of sources. Topics such as detection criteria and the effects of learning, alerting, and uncertainty about the new dynamics are included by reference only. Author

N67-15857*# Purdue Univ., Lafayette, Ind.
ADAPTIVE MODEL OF THE HUMAN OPERATOR IN TIME-VARYING CONTROL TASK
E. E. Gould and K. S. Fu *In* NASA, Washington Manual Control 1966 p 85–97 refs (See N67-15850 06-05) GPO: HC $2.50; CFSTI: MF $0.65

A model is presented for the human operator engaged in one-dimensional, compensatory, visual-manual tracking. Instead of a lumped input-output model, the human operator is considered as a system consisting of an input device (visual stimulus), an adaptive controller (central nervous system), and an actuator (arm and muscle mechanism). The main concern of this paper is modeling the strategy of the adaptive controller section. Pattern recognition techniques, which usually attempt to mimic human behavior are used in the model to identify the type of plant being controlled. This basis for a model is then augmented by more conventional techniques to more closely approximate human behavior. The model has been simulated and is presently undergoing extensive tests. Author

N67-15858*# Massachusetts Inst. of Tech., Cambridge.
MAN IN AN ADAPTIVE AND MULTILOOP CONTROL SYSTEM.
Y. T. Li *In* NASA, Washington Manual Control 1966 p 99–105 (See N67-15850 06-05) GPO: HC $2.50; CFSTI: MF $0.65

While consideration of the difficulties involved in the control of a multiloop system makes it appear that man's role is very limited, it is emphasized that the human operator is extremely important because of his visual perception of his natural surroundings and his ability to make impromptu adaptive control under unexpected or very complicated conditions. Because numerous accidents are averted by experienced pilots, manual control should be a part of the primary control loop of the dominating vehicle output for the critical phase of operation. In a multiloop system, man should be burdened only by tasks that must be performed under adverse conditions; automatic devices should be used for load-relieving purposes. Both system design and operator training should place the emphasis on operator effectiveness in emergency situations. Man's role in a continuous adaptive control loop is delineated; and the multiloop in vehicle control systems, control problems of higher order systems, and an intercoupled multiloop system are discussed. M.W.R.

N67-15859*# Cornell Aeronautical Lab., Buffalo, N. Y.
TIME VARYING AND NONLINEAR MODELS OF HUMAN OPERATOR DYNAMICS
W. W. Wierwille and G. A. Gagne *In* NASA, Washington Manual Control 1966 p 107–108 (See N67-15850 06-05) GPO: HC $2.50; CFSTI: MF $0.65
(Contract NAS1-4920)

Nonlinear synthesis models are discussed in relation to manual control problems. Important gains in accuracy can be

attained by using nonlinear and time-varying models that are at the present time largely in the research stage and are not as yet ready for use in system design. Time-varying linear models will generally possess errors of approximately 10% for a smoothing time of approximately 5 sec, while only 6% error is attributed to nonlinear time-varying errors. Nonlinear constant-coefficient models are considered to have 20% error. It is noted that there appears to be no simple relationship between the time variations of the linear time-varying transfer characteristics and the signals of the corresponding manual control system. Individual time variations appear to be a functon of the biological mechanism of the human operator whose fluctuatins are random functions of time that are not deterministic functions of the system signals. M.W.R.

N67-15860*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

USEFULNESS OF TRANSINFORMATION AS A MEASURE OF HUMAN TRACKING PERFORMANCE

T. Wempe and D. Baty *In its* Manual Control 1966 p 111–129 refs (See N67-15850 06-05) GPO: HC $2.50; CFSTI: MF $0.65

This study was conducted to determine the applicability of information theory concepts to human tracking tasks. Data for one subject's tracking performance were analyzed for various bandwidths of the forcing function. The task was to track a filtered gaussian input, displayed on a cathode ray tube, by operating a controller with fixed-gain dynamics. This paper first examines different ways of applying information theory concepts to this tracking task as related to definitions of signal and noise. Then, describing functions and measures of information processing rates were determined for the experimental data. This provided material to examine measures of transinformation rates along with relative tracking error for the same task. Finally, the concept of human capacity as related to this simple tracking task was investigated. Author

N67-15861*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

MEASURED INFORMATION CAPACITY AS A PERFORMANCE INDEX IN MANUAL TRACKING TASKS

Patrick A. Gainer *In its* Manual Control 1966 p 131–139 refs (See N67-15850 06-05) GPO: HC $2.50; CFSTI: MF $0.65

Two applications of the concepts of information theory to the assessment of human performance in compensatory tracking tasks are presented. One analyzes the input and output of the whole system, treating as noise any part of the output that is not correlated to the input through a linear dynamic system. The second application considers only the tracking error signal and the filtering operations that must be performed on it. Although the second approach is rather crudely approximated, it shows that the human operator may logically use his information capacity in ways which are not made apparent by linear analysis of throughput. Until more is learned of the internal dynamics of the human operator, there is little hope for the discovery of a single performance index for evaluation of control and display systems. Author

N67-15862*# TRW Systems, Redondo Beach, Calif.

HUMAN PERFORMANCE IN SINGLE-AXIS AND TWO-AXIS TRACKING SYSTEMS

E. P. Todosiev, R. E. Rose, and L. G. Summers *In* NASA, Washington Manual Control 1966 p 143–158 refs (See N67-15850 06-05) GPO: HC $2.50; CFSTI: MF $0.65
(Contract NAS1-4419)

A compensatory tracking experiment was performed on single and uncoupled two-axis tracking systems to determine the effects of training and task difficulty on the parameters of a describing function model of the human operator. The plant dynamics were identical in both the single-axis system and the symmetrical two-axis system. Second-order dynamics consisting of a pure integration and first-order lag were used. Task difficulty was varied by changing the magnitude of the lag time constant and the frequency bandwidth of the input disturbance. Analysis of system tracking error showed that the rate at which error decreased with training was dependent upon task difficulty. The amplitude ratio and phase lead of the model describing function increased with training, indicating an increase in open-loop bandwidth and a decrease in phase margin. Increasing the plant lag time constant resulted in an increase in the model lead time constant and a decrease in the zero frequency gain. No significant difference was found to exist in the tracking error per axis between the two-axis tasks and the single-axis tasks. However, the model lead time constant was significantly greater in two-axis tracking. Author

N67-15863*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

TWO-DIMENSIONAL MANUAL CONTROL SYSTEMS

William H. Levison *In* NASA, Washington Manual Control 1966 p 159–180 refs (See N67-15850 06-05) GPO: HC $2.50; CFSTI: MF $0.65

Experiments were conducted to determine what modifications to the current models of the human controller of single-variable systems are necessary for them to be good representations of the controller in two-variable situations. These experiments were performed with a single compensatory display and a single two-axis control. Two descriptors of performance were obtained for each axis: the normalized mean squared error, and the describing function. Of prime interest was the extent to which performance on a given axis was modified by the requirement of simultaneously tracking a second axis. Two-axis performance degradation was small when the tracking conditions were homogeneous and when the inputs were heterogeneous. Large and significant performance differences were seen when the dynamics were heterogeneous. Three factors affect human controller characteristics in two-axis control: visual-motor interaction, differential allocation of attention, and nonhomogeneity of required equalization when the controlled-element dynamics are nonhomogeneous. A simple model was developed to predict visual-motor interference effects. Single-axis describing-function models for the human controller should be modified to include the effects of these factors to obtain accurate predictions of human-controller characteristics in two-axis situations and also in higher dimensional control situations. Author

N67-15864*# Systems Technology Inc., Inglewood, Calif.

PILOT DESCRIBING FUNCTION MEASUREMENTS IN A MULTILOOP TASK

R. L. Stapleford, D. T. McRuer, and R. Magdaleno *In* NASA, Washington Manual Control 1966 p 181–204 refs (See N67-15850 06-05) GPO: HC $2.50; CFSTI: MF $0.65
(Contract NAS2-1868-3)

The quasi-linear pilot model and adjustment rules evolved for single loop systems are considered applicable to the command loop of multiloop control situations with an integrated display. With certain reservations, this pilot loop model is also applicable to inner loop closures. To reduce the inadvertent excitations of a subsidiary or nuisance mode, the pilot will adopt a control crossfeed; and even while providing both crossfeed and inner-loop damping, pilot performance can be as good as that for a single loop task. The subjective opinion of the pilot, however, becomes severely degraded. In the event of several feedback possibilities, the pilot can select those which permit the best performance with the least effort on his part. Describing function measurements for multiloop systems are considered, and details are presented for the experiments undertaken. M.W.R.

N67-15865*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PILOT RESPONSE IN MULTILOOP TRACKING TASKS IN COMBINATION WITH SIDE TASKS

James J. Adams *In its* Manual Control 1966 p 205–209 refs (See N67-15850 06-05) GPO: HC$2.50; CFSTI: MF $0.65

Multiloop tracking system characteristics show that linear pilot models aid in a quantitative understanding of damper failure. Human control of a system based on horizontal translation control of a simulated Apollo lunar excursion module was studied for a letdown maneuver, with six degrees of freedom. Performance was smooth when pilots followed a predetermined pitch program, and then adjusted pitch attitude and thrust to establish a stable hovering condition and to reduce horizontal velocity to zero. Additional side tasks had no affect when the prescribed program was followed, but they did effect ability to establish the hovering stability. Closed loop characteristics illustrated before and after a damper failure indicate the normal system has an attitude mode of motion with positive damping ratio. When vehicle damping is removed, the ratio becomes negative; and when the analog model representing the response of the human controlling an undamped vehicle is substituted, system characteristics again become stable. M.W.R.

N67-15866*# Honeywell, Inc., Minneapolis, Minn.
SYMBOLIC AND PICTORIAL DISPLAYS FOR SUBMARINE CONTROL
Robert C. McLane and James D. Wolf *In* NASA, Washington Manual Control 1966 p 213–228 refs (See N67-15850 06-05) GPO: HC $2.50; CFSTI: MF $0.65
(Contract Nonr-3675(00))

The research program leading to the development of several integrated display concepts for nuclear submarines is described. The experiments established guidelines for use of these integrated displays in vehicle control including monitoring and mission plan revision as a function of external constraints such as attacking weapons systems. The displays evaluated were classed in two general categories—symbolic and pictorial. The experimental approach employed tests designed to reveal differences between the displays, including measurement of tracking performance with forced sampling or blanking; recording reaction, judgement, and decision times in response to the presence of a homing torpedo; and determination of the correctness of the decision on collision imminence. There was no appreciable degradation in tracking performance due to periodic blanking of the display for as long as 75% of a 10-sec period. The pictorial or contact analog format produced lower tracking error scores than those with symbolic depth-azimuth format. This result was a general trend which may be attributable to their perceptual differences and differences in their quickening equations. The predictor display yielded a significantly smaller number of collisions than any of the other display configurations. There were no significant differences between the displays in the recordings of reaction, judgment, and decision times. Author

N67-15867*# Massachusetts Inst. of Tech., Cambridge.
SOME EFFECTS OF MOTION CUES ON MANUAL TRACKING
Lawrence R. Young *In* NASA, Washington Manual Control 1966 p 231–239 refs (See N67-15850 06-05) GPO: HC $2.50; CFSTI: MF $0.65

It has been adequately demonstrated that sustained high acceleration or vibration can have a deleterious effect on tracking ability. This paper considers some situations in which the motion cues, as felt in flight or moving base simulation, yield a significant improvement in pilot performance. The first of these situations is in a control task requiring more lead compensation than is easily developed from visual displays. The vestibular and tactile sensations contribute velocity and acceleration information which is used in stabilization. Experiments on control of inverted pendulums and VTOL's, with and without motion cues, demonstrate the extent to which this lead is used in certain tasks. Tests of labyrinthine-defective patients on similar tasks demonstrated the critical importance of vestibular inputs. The importance of motion cues in rapid adaptation to controlled element failures was investigated in a simulated blind landing experiment. Motion effects were found to be important in a class of flexible booster control experiments. These results were combined with many comparisons of fixed-base, moving-base, and flight experiments in the literature to arrive at some general conclusions regarding the effects of motion cues on tracking. Author

N67-15868*# National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif.
ACCELERATION STRESS EFFECTS ON PILOT PERFORMANCE AND DYNAMIC RESPONSE
Melvin Sadoff and C. B. Dolkas *In its* Manual Control 1966 p 241–257 refs (See N67-15850 06-05) GPO: HC $2.50; CFSTI: MF $0.65

A wide range of acceleration environments, varying from zero gravity to high sustained accelerations were studied in relation to pilot performance and dynamic response. Results indicate that the control-performance decrements observed at high sustained accelerations were attributable to decreased pilot gains and corresponding reductions in open-loop system crossover frequency. Limited results for extreme vibratory accelerations suggest that performance deterioration was associated with a reduction in pilot lead equalization (and a corresponding reduction in open-loop crossover). Under short-term weightless conditions, performance in a simulated control task was appreciably poorer than under comparable 1 g conditions for one of two sets of simulated vehicle dynamics investigated. This was attributed primarily to increased pilot excitation of the vehicle's lightly damped short-period mode. Data from Voskhod flights indicated that cosmonauts did not perform as well in a simulated control system as during ground training sessions. Author

N67-15869*# Defense Research Corp., Santa Barbara, Calif.
THE EFFECT OF MINOR ALCOHOL STRESS ON TRACKING SKILL
C. B. Gibbs *In* NASA, Washington Manual Control 1966 p 259–267 refs (See N67-15850 06-05) GPO: HC $2.50; CFSTI: MF $0.65

Twenty men were tested in step-input tracking, with minor stress imposed by moderate alcohol dosage and an incompatible directional relation between control and display. Directional errors, response latencies, and eye movements were recorded before and after drinking, when breathalyzer readings were zero, and at 0.05 and 0.1% breathalyzer levels which may be produced in a man weighing 160 pounds by drinking two and four 12-ounce bottles of beer, respectively. Alcohol caused a progressive increase in response latencies in and errors ($p<0.01$); there was no evidence for a threshold below which alcohol has no adverse effect. The test emphasized the markedly different effects of the same alcohol dosage on the skill of different subjects, but habitual drinkers obtained no undue advantage on the test. The task was learned quickly, and extensive practice did not reduce the discriminatory power of the test. The effects of a dose producing a 0.05% breathalyzer reading were not significantly different in an ascending or descending series of levels of intoxication. The alcohol dosages tested had no significant effect on simple reaction time. Author

N67-15870*# Hughes Aircraft Co., Culver City, Calif.
AN EVALUATION OF THREE TYPES OF HAND CONTROLLERS UNDER RANDOM VERTICAL VIBRATION
A. Z. Weisz, R. W. Allen, and C. J. Goddard *In* NASA, Washington Manual Control 1966 p 269–277 refs (See N67-15850 06-05) GPO: HC $2.50; CFSTI: MF $0.65

Investigated was the effect of hand control design on continuous manual control performance in a vibration environment. Degradations in manual tracking due to whole-body vertical vibration were experimentally determined. The three controllers compared in the study consisted of: (1) a standard free-moving hand control

without spring centering and with negligible friction or viscous damping; (2) a viscously damped low-inertia pencil stick without spring centering; and (3) a torque stick with negligible motion response to applied torques about the center of the hand grip. Results of the study indicate that the speed of response possible with a rigid controller leads to improved tracking performance in both static and vibration environments. K.W.

N67-15871*# National Aeronautics and Space Administration, Flight Research Center, Edwards, Calif.
HUMAN DESCRIBING FUNCTIONS MEASURED IN FLIGHT AND ON SIMULATORS
Harriet J. Smith *In its* Manual Control 1966 p 279–290 refs (See N67-15850 06-05) GPO: HC $2.50; CFSTI: MF $0.65

Comparisons have been made between human describing functions measured in flight and on the ground using two different types of ground simulation. A T-33 variable–stability airplane was used for the in-flight measurements. The ground tests were conducted in the T-33 airplane on the ground with simulated instrument flight and also on a general-purpose analog computer in conjunction with a contact analog display. A multiple-degree-of-freedom controlled element was used in a single-loop compensatory tracking task. The input disturbance in each case consisted of the sum of 10 sine waves with a cutoff frequency of 1.5 radians per second. No significant difference is indicated between the average describing functions measured in flight and those measured in a fixed-base simulator; the variance was considerably higher in the flight data. The system open-loop describing functions measured in the fixed-base simulator agreed well with previous results in which the tracking task was similar, although the controlled-element dynamics were different. Average linear coherence was close to the values in this investigation, although the linear-correlation function was always equal to 1. Author

N67-15872*# Massachusetts Inst. of Tech., Cambridge.
PREVIEW CONTROL BEHAVIOR AND OPTIMAL CONTROL NORMS
T. B. Sheridan, B. F. Fabis, and R. D. Roland *In* NASA, Washington Manual Control 1966 p 293–310 refs (See N67-15850 06-05) GPO: HC $2.50; CFSTI: MF $0.65
(Grant NsG-107-61)

A model, based on the theory of optimal control, is presented for characterizing the human operator in a preview control task, that is, where he can observe the input targets and their importance prior to the time he must initiate a response to them. While in need of much further development from the behavioral science point of view, the model provides a frame of reference for investigation of performance value and learning in manual control. Two exploratory experiments are reported which may illustrate some relevant experimental variable and provide a rough comparison of the human operator to an optimal preview controller. Author

N67-15873*# Bunker-Ramo Corp., Canoga Park, Calif.
STUDIES IN OPTIMAL BEHAVIOR IN MANUAL CONTROL SYSTEMS: THE EFFECT OF FOUR PERFORMANCE CRITERIA IN COMPENSATORY RATE-CONTROL TRACKING
Richard W. Obermayer, Raymond B. Webster, and Frederick A. Muckler *In* NASA, Washington Manual Control 1966 p 311–324 refs (See N67-15850 06-05) GPO: HC $2.50; CFSTI: MF $0.65
(Contract NAS2-3113)

Twelve college students performed compensatory tracking with rate control dynamics (1/s) and a low-frequency forcing function composed o f the sum of six sinusoidal components. After two practice sessions, the subjects performed the basic task with four performance criteria: (1) keep the display bar in the center, (2) only keep the display bar from exceeding 1-centimeter boundaries on the display face, (3) minimize a total score which is the sum of mean-squared display deviation and mean-squared control deflection, and (4) minimize mean-squared display deviation. The following kinds of information were collected: learning curves; display, control, and total scores; amplitude ratio and phase at each forcing function frequency; centimeter tolerance-band counts; correlation coefficients; reversals; oscillograph recordings; control and display amplitude distribution; and average control response as a function of display deviation. The data show different levels of human control behavior and nonamplifier-type behavior, and yield methodological implications. Author

N67-15874*# Battelle Memorial Inst., Columbus, Ohio.
HUMAN DECISION-MAKING IN MANUAL CONTROL SYSTEMS
R. E. Thomas and J. T. Tou *In* NASA, Washington Manual Control 1966 p 325–334 refs (See N67-15850 06-05) GPO: HC $2.50; CFSTI: MF $0.65

A model is proposed to describe human decision making in manual control systems. The human operator in the control loop is represented by a model which will generate an output consisting of (1) operational control actions as a result of sequential decision-making and (2) verbal statements or heuristics of how to achieve optimal control. The operational control actions are generated by a search algorithm, and the verbal statements are determined through detection of invariance of variables associated with minimum incremental cost. At high levels of generality and verbal prescriptions for obtaining optimal control are called heuristics. By using heuristics adaptive features can be introduced into the search algorithm. The proposed model will carry out sequential evaluation of the validity of the heuristics which are derived on the basis of past experience. By associating a Bayesian probability with the derived heuristic, this model simulates the evolution of a heuristic to a high subjective probability of being valid, even though the controller may have difficulty in executing the heuristic as shown by control actions which do not optimize the criterion function. An experiment is suggested for testing the validity of the proposed model. Author

N67-15875*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
DIFFERENTIAL GAMES AND MANUAL CONTROL
Sheldon Baron *In its* Manual Control 1966 p 334–345 refs (See N67-15850 06-05) GPO: HC $2.50; CFSTI: MF $0.65

Variational methods are used to solve a particular pursuit-evasion differential game. The problem involves the determination of optimal strategies for both the pursuer and evader. The performance measure is the miss distance at some fixed terminal time. Both pursuer and evader have limited control energy. The performance of a trained research pilot, for both single- and two-axis control tasks is compared with that of the optimal pursuer. State vector display and "quciened" display are discussed. A film showing typical pilot performance is presented. The results suggest that differential game problems could be quite useful in the study of manual control. Author

N67-15876*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
DYNAMICAL SYSTEM MODELING OF HUMAN OPERATORS–A PRELIMINARY REPORT
Peter L. Falb and George Kovatch *In its* Manual Control 1966 p 345–358 refs (See N67-15850 06-05) GPO: HC $2.50; CFSTI: MF $0.65

Results from control theory are applied to the development of dynamical system models for human operators in a control loop. Linear differential equation models are examined to determine the model from estimates of the impulse response. The system order, the system matrix, and the system gains are adjusted.

Nonlinear Volterra series models are also considered and an identification method is used to estimate the kernels. Author

N67-15877*# Systems Technology Inc., Ingelwood, Calif.
A "CRITICAL" TRACKING TASK FOR MAN-MACHINE RESEARCH RELATED TO OPERATOR'S EFFECTIVE DELAY TIME
H. R. Jex, J. D. McDonnell, and A. V. Phatak *In* NASA, Washington Manual Control 1966 p 361–377 refs (See N67-15850 06-05) GPO: HC $2.50; CFSTI: MF $0.65
(Contracts NAS2-2288; AF 33(615)-[illegible])

A closed-loop compensatory tracking task, which yields a measure of the human operator's time delay characteristics while tracking, constrains his behavior to within very narrow limits, and provides a low variability indicator of the operator's tracking ability, was analyzed based on recent human response research. The results of an experimental program are described, which enables describing function and critical task measures to be compared. An "autopaced" critical task mechanization and operating procedure is described which yields consistent, reliable, and very low variance measurements of the critical levels of instability. An analysis of the measured human operator describing functions shows that, when operating near criticality, the subject's behavior is adequately represented by the most recent human-operator describing-function models and adaptation laws. Further, the extrapolation of describing function data to the critical level of instability shows that the operator is constrained by the vanishing stability margins. The just-controllable first-order divergence is shown to be related dominantly to the operator's effective time delay, and secondarily to low-frequency neuromuscular adaptation effects. Very good agreement is demonstrated between theory and experiment for both stability and performance parameters. Author

N67-15878*# Dunlap and Associates, Inc., Darien, Conn.
DESIGN APPLICATIONS OF ADAPTIVE (SELF-ADJUSTING) SIMULATORS
Charles R. Kelley *In* NASA, Washington Manual Control 1966 p 379–401 refs (See N67-15850 06-05) GPO: HC $2.50; CFSTI: MF $0.65
(Contract Nonr-4986(00))

The usefulness of adaptive simulators in manual control system design is explored. The history and development of the field of adaptive vehicle simulaton is reviewed. The technique of adaptation most suitable for design studies is one in which operator performance is kept at a present criterion level by means of adaptive changes in task difficulty. This technique permits design variables to be assessed without the intervention of operator error scores. The performance criterion used to measure operator performance is important in adaptive as well as nonadaptive simulation. Time-on-target scores were analyzed and found to be excessively imprecise. The recommended performance criterion for many applications is rms error in one axis and vector error in two or more independent axes. Example design data are presented with respect to (1) display gain, (2) continuous versus on-off control, and (3) one versus two versus three axes. Data were gathered in each case on an acceleration control task in which forcing function amplitude was varied adaptively. The relation of each design variable to forcing function amplitude, with operator error constant, is described for the example task. Author

N67-15879*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge Mass.
DISCUSSION OF SPECTRAL HUMAN-RESPONSE ANALYSIS
Lawrence W. Taylor *In its* Manual Control 1966 p 403–412 refs (See N67-15850 06-05) GPO: HC $2.50; CFSTI: MF $0.65

Estimates of describing functions and associated parameters that represent a human pilot performing a compensatory tracking task, while being subjected to a random-appearing input, are expressed in terms of cross- and power-spectral-density functions. The expression most commonly used for spectral densities is the Fourier transform of the autocorrelation and cross-correlation functions. Use of an equivalent expression for spectral-density functions, the product of the Fourier transforms of the signals divided by the record length, makes several simplifications become evident. The estimates of the human describing function are seen to be unchanged by correlation with the signals and are shown to be equal to the ratio of the Fourier transforms of the pilot's output and error. The expression for the linear-correlation coefficient is shown to be ill-defined, since it equals 1 under all circumstances. Alternate definitions of this parameter are discussed. The need for a sum of sine waves for an input is also discussed, and the technique for making measurements of the remnant is outlined. In addition to the analytical consideratons, a computational advantage results which enables improvements in accuracy. Author

N67-15880*# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
ANALYSIS AND PREDICTION OF PERFORMANCE OF A DIGITAL COMPUTER FACILITY FOR FLIGHT SIMULATION STUDIES
M. C. Grignetti and J. I. Elkind *In* NASA, Washington Manual Control 1966 p 413–417 (See N67-15850 06-05) GPO: HC $2.50; CFSTI: MF $0.65

Theory and partial results of the design are presented. The facility is to provide a group of experimenters with the means of monitoring the signals and data obtained from their experiments while they are being run (1) for extracting information from these signals in order to control the experiments; (2) for recording the data and signals in permanent files; (3) for editing these data; and (4) for applying of analysis techniques to the edited data. Since it is assumed that demands for service will be random and subject to unpredictable interruptions and delays, the system is designed to service a nonpredictable, randomly varying load. Markov models forming the basis of queuing theory are recommended to represent and analyze the system's behavior. Computer problems of real-time and high-priority are discussed, and user probabilities are determined by the analytical and the Monte Carlo methods. K.W.

N67-16011*# Systems Technology, Inc., Hawthorne, Calif.
MODEL OF HUMAN OPERATOR RESPONSE TO STEP TRANSITIONS IN CONTROLLED ELEMENT DYNAMICS
D. H. Weir and A. V. Phatak Washington, NASA, Jan. 1967 42 p refs
(Contract NAS2-1868-4)
(NASA-CR-671) CFSTI: HC $3.00/MF $0.65 CSCL 05H

A model is derived for describing and predicting human operator dynamic response during sudden changes in the vehicle or controlled element dynamics. Data upon which the model is based are presented also. The model features distinct modes of behavior which are selected successively during the transition between the initial and final stationary tracking situations. The first transition mode is a retention phase which is modeled by the pretransition operator describing function in closed-loop control of the new controlled element dynamics. The next phase is characterized by nonlinear time optimal control. Finally, the operator switches to the quasi-linear describing function appropriate to closed-loop control of the new dynamics under stationary conditions. Author

N67-16012*# Systems Technology, Inc., Hawthorne, Calif.
A "CRITICAL" TRACKING TASK FOR MAN-MACHINE RESEARCH RELATED TO THE OPERATOR'S EFFECTIVE DELAY TIME. PART II: EXPERIMENTAL EFFECTS OF SYSTEM INPUT SPECTRA, CONTROL STICK STIFFNESS, AND CONTROLLED ELEMENT ORDER
J. D. McDonnell and H. R. Jex Washington, NASA, Jan. 1967 56 p refs
(Contract NAS2-2288)
(NASA-CR-674) CFSTI: HC $3.00/MF $0.65 CSCL 05H

The Critical Task consists of a closed-loop tracking task in which an increasingly unstable controlled element is used to yield a measure of the operator's effective time delay while tracking. In this part of the report, the task has been further developed through the analysis of additional data. In a series of experiments, it was found that the human operator's characteristics do not change as the system input level is decreased; hence, the critical task yields a valid limit when excited solely by the operator's remnant. The effects on the operator of different control stick types are investigated, and the differences in critical task scores are related to the operator's describing function characteristics. Step reaction time data are compared with the continuous measures of effective time delay and the autopacer scores. A sample analysis to determine the number of autopacer trials necessary to achieve a confident measure is made. Finally, data are presented for a second-order critical task in which on integrator precedes the first-order divergence. Author

N67-16027*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
EXPERIMENT D-12, ASTRONAUT MANEUVERING UNIT
John W. Donahue *In* NASA, Washington Manned Space-Flight Expt., Gemini IX Mission 1 Nov. 1966 p 55–96 (See N67-16021 06-30) CFSTI: HC $3.00/MF $0.65

The astronaut maneuvering unit (AMU) experiment was designed to provide experience in extravehicular maneuvering operations in the Gemini missions. The AMU consists of two basic modules. The extravehicular life support system chestpack contains the life support system, emergency oxygen supply, and all systems status and malfunction displays. The backpack contains the propulsion, flight control, oxygen supply, malfunction detection, and communications systems. Detailed descriptions of these systems are given. The Gemini IX-A AMU mission called for inspection, preparation, and donning activities followed by maneuvering evaluations. The AMU activities were terminated before the donning was completed. More work effort than anticipated was needed by the EVA pilot to maintain his position in preparing the AMU for flight, which caused his visor to completely fog. Despite the positioning problem, the preparation tasks were completed. Details of these activities are discussed. R.N.A.

N67-16084# Federal Aviation Agency, Washington, D. C. Office of Aviation Medicine.
PROBLEMS IN DEPTH PERCEPTIONS: EQUIDISTANCE JUDGEMENTS IN THE VICINITY OF A BINOCULAR ILLUSION
Frank L. Agee Jr. (M.S. Thesis), and Walter C. Gogel Jul. 1966 12 p refs
(AM-66-24; AD-641476) CFSTI: HC $3.00/MF $0.65

Judgments of the size and distance of objects are sometimes made in aircraft under background-viewing conditions that may themselves create false sensory impressions (illusions). In this study, the effects of a background illusion on judgments of the size and distance of objects that were independent of that background were examined. Misleading size cues associated with a binocularly observed trapezoidal window produced an apparent depth orientation of the window that was different from its physical orientation. As expected, it was found that errors occurred in adjusting two other objects (disks) to apparent equidistance with each other in the presence of the window and that the direction of the errors in apparent equidistance was related to the direction of the errors in the perceived slant of the trapezoidal window. It was less clear that errors in the judgment of apparent equidistance occurred when the orientation of the window and the separation of the disks were vertical rather than horizontal. Possible explanations for discrepancies between the magnitude of the perceptual errors associated with the trapezoidal window and those associated with the equidistance judgments are discussed. Author (TAB)

N67-16147# United States Rubber Co., Mishawaka, Ind.
LIGHTWEIGHT INSULATED FOOTWEAR Final Report
Robert W. Pooley, Leighton E. Fisher, Alexander D. Shaw, III, and Conrad S. Rohs Natick, Mass., Army Natick Labs., Sep. 1966 150 p refs
(Contract DA-19-129-AMC-690(N))
(TR-67-23-CM; AD-640629) CFSTI: HC $3.00/MF $0.65

A number of candidate materials were compounded, tested, and evaluated with an aim toward the development of a lightweight (15 oz. per boot), impermeable, (water absorption maximum weight 5%), insulated, (for service down to -20 deg.) boot for periods of up to 2 hours of inactivity. These materials included expanded elastomers and plastics, solid plastics, metals, fabrics, adhesives, and coating materials. Design and fabrication studies were conducted to incorporate the most promising materials into a prototype boot, and to determine the insulating properties of the materials used singly and in combination with each other. Based on the data obtained, prototype boots were assembled. An experimental pull-on type boot weighing 15 1/2 onuces was worn by the Project Officer in the Climatic Test Chambers at the U. S. Natick Laboratories at -30F. for a period of 2 hours. These studies indicate the feasibility of producing lightweight insulated boots through materials research. Author (TAB)

N67-16216# RAND Corp., Santa Monica, Calif.
CYBERNETICS
5 Oct. 1966 9 p Transl. into ENGLISH from the book "Kul'tura, Nauka, Iskusstvo SSSR" Moscow, Politizdat, 1965 p 97–101
(LT-66-55; AD-640505) CFSTI: HC $3.00/MF $0.65
Translation of Russian research: Cybernetics. Author (TAB)

N67-16243# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
X-RAY DOSE AND ENERGY DETERMINATION BY PERSONAL FILM MONITORING [BESTIMMUNG DER PERSONENDOSIS UND ENERGIE DER ROENTGENSTRAHLUNG UND NACH DER FILMSCHWAERZUNGSMETHODE]
T. Musialowicz and J. Wysopolski *In its* Nukleonika, Vol. VIII 1966 p 174–183 refs In GERMAN; ENGLISH summary (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

A method of determining X-ray dose and energy by personnel film badge monitoring is described. The method increases the precision of dose and energy estimation. Relative error in estimating the dose of X-radiation up to 200 kV is the range of ±30%. Author

N67-16341# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
THE EFFECT OF PRIOR EXPERIENCE ON ACQUIRING SKILL ON A SIMULATED INERTIAL CONTROL TASK
Richard Geiselhart Jul. 1966 33 p refs
(AMRL-TR-66-25; AD-641389) CFSTI: HC $3.00/MF $0.65

The performance of test pilots and college student subjects in acquiring the skill to control the attitude of a simulated space vehicle was compared. The purpose of the comparison was to

investigate transfer of training to this type of task as a function of prior pilot experience and determine the degree to which one may generalize from students to pilots. There was also a further breakdown of the student group into experimental subgroups to assess the effects of type of control/display relationship and the order of part training on the acquisition of the vehicular control task. The secondary comparisons within the student group were to determine optima training conditions to make the comparison with the pilots as equitable as possible. The conclusions based on the results of the study were (1) there appear to be more positive transfer effects than negative in transitioning from flying aircraft to a simulated inertial control task; (2) the degree to which generalizations can be made from students to pilots depends on the amount of training given the students provided an optimal control/display relationship is used; (3) previously untrained subjects can achieve skill levels comparable to pilots on this type of task, but it takes more trials for the nonpilot to do so; (4) order of part training does not appear to be an important variable in training on this type of task. Author (TAB)

N67-16342# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.

EFFECTIVE TECHNICAL COMMUNICATIONS MECHANICAL DESCRIPTION, EXPERIMENT III

Richard M. Davis 1966 91 p ref

(AFIT-TR-66-15; AD-641251) CFSTI: HC $3.00/MF $0.65

The effects of three variables on the effectiveness of a written technical communication were tested in a 3x2x2 factorial experiment. The subject matter was a description of a simple mechanism. The variables were (1) the manner in which the size and shape of the machine were presented (drawings alone, drawings with verbal description, verbal description alone), (2) introduction (present or absent), and (3) internal orienting material (present or absent). The effectiveness of the message was measured by (1) comprehension, (2) reading time, (3) the readers impression of the authors knowledge of the subject matter, and (4) the readers impression of the authors competence as a writer. The two audiences tested were (1) 186 very bright men with known technical interests who had been instructed in technical writing and (2) 112 very bright men with known technical interests who had not been instructed in technical writing. The twelve versions of the reading passage were assigned to the subjects in each audience on a random basis. Each subject read his passage, recorded his reading time, completed the comprehension test, and made the two judgments. TAB

N67-16351# General Electric Co., Schenectady, N. Y. Research and Development Center.

DEVELOPMENT OF A REVERSIBLY FROSTIBLE TRANSPARENCY FOR A NUCLEAR FLASH EYE PROTECTION SHUTTER Final Report, Jun. 1965–Jul. 1966

C. D. Doyle and S. Aftergut Jul. 1966 63 p refs

(Contract AF-41(609)-2710)

AD-642732) CFSTI: HC $3.00/MF $0.65

The feasibility of a reversibly frostible window for flashblindness protection was investigated. Fluids were studied which frost when electrically charged by either corona or glow discharge. Optical and temporal performance was measured for several such fluids. Under the conditions employed, five frost layers in series were enough to bring about an increase in apparent density in the incident direction to the requisite level of 3. Several of the experimental fluids frosted within the requisite 150 microsec., but they did not do so consistently, primarily because of the capriciousness of the gaseous discharge method of injecting charges into a fluid surface. Eventual success of the frostible window concept hinges on the development of an efficient charging technique. Author (TAB)

N67-16358# System Development Corp., Santa Monica, Calif.

AN EXPLORATORY INVESTIGATION OF PROGRAMMER PERFORMANCE UNDER ON-LINE AND OFF-LINE CONDITIONS

E. E. Grant and H. Sackman 2 Sep. 1966 41 p refs

(Contract AF 19(628)-5166; ARPA Order no. 773)

(SP-2581; AD-640654) CFSTI: HC $3.00/MF $0.65

An experiment conducted at System Development Corporation compared the program debugging performance of programmers working under conditions of on-line and off-line access to a computer. This paper describes that experiment; it is the first known study measuring the performance of programmers under controlled conditions for a standard task. Two groups of six programmers each, comprising a total sample of 12 subjects, debugged two types of programs under on-line and off-line conditions in accordance with a Latin-Square experimental design. The on-line condition was the normal mode of operation for the SDC Time-Sharing System; the off-line condition was a simulated closed-shop with a two-hour turn around time. Statistically significant results indicated faster debugging under on-line conditions. Perhaps the most important practical finding of this study, overshadowing on-line/off-line differences, concerned the large and striking individual differences in programmer performance. Attempts are made to relate observed individual differences to objective measures of programmer experience and proficiency through factorial techniques. In line with the exploratory objectives of this study, methodological problems encountered in designing an conducting this type of experiment are described, limitations of the findings are pointed out, hypotheses are presented to account for the results and suggestions are made for further research. Author (TAB)

N67-16361# Human Engineering Labs., Aberdeen Proving Ground, Md.

GROUP BEHAVIOR IN CONFINEMENT: REVIEW AND ANNOTATED BIBLIOGRAPHY

Alfreda B. Honigfeld Oct. 1965 116 p refs

(TM-14-65; AD-640161) CFSTI: HC $3.00/MF $0.65

Field and laboratory confinement studies were reviewed to evaluate existing information and to identify areas where future research is needed. The studies reviewed deal with confining two or more people in a restricted space for a prolonged period of time; particular attention was devoted to how such conditions degrade performance. Few of the studies bear on the Armys chief interest in confinement: how men will perform during and after prolonged confinement in armored vehicles. The review concludes by recommending ways to make future studies of confinement more directly relevant to the Army's interest. Author (TAB)

N67-16408# TRW Equipment Labs., Cleveland, Ohio.

WATER AND CARBON REMOVAL FROM CARBON DIOXIDE REDUCTION SYSTEMS Final Report, Apr. 1965–Mar. 1966

Andrew D. Babinsky, and Stephen J. Derezinski Wright-Patterson AFB, Ohio. AMRL, Jun. 1966 53 p refs

(Contract AF 33(615)-2298)

(ER-6652-5; AMRL-TR-66-83; AD-642594) CFSTI: HC $3.00/MF $0.65

Methods suitable for use in a weightless environment for removing water and carbon from carbon dioxide reduction process systems were investigated. Water removal studies were conducted using a porous metal, plate-type, condenser-separator to remove the water from the exit gas streams of both Sabatier and Bosch type carbon dioxide reduction reactors. Water remaining in the effluent stream ranged from 0.97 to 2.08 percent by volume with the Sabatier reactor, and 0.78 to 0.92 percent with the Bosch reactor. A regenerative chemical dryer used to increase the reaction rate of the Bosch reactor, resulted in relatively minor changes in the reaction rate in steady state operation. Carbon flow pattern tests were conducted to determine design characteristics of a carbon separator-filter. A combination centrifugal separator and porous

metal filter was used to remove carbon from the recycle flow stream and pass approximately 99 percent of the carbon to the carbon collector. Periodic back flow through the filter removes the remaining carbon from the filter. The Bosch reactor utilizes flat iron catalyst plates stacked on a hollow rotating shaft. Carbon is dislodged from the rotating plates by carbon removal fingers projecting between the catalyst plates. Reaction gases flowing through the reactor carry the carbon out of the reactor to the filter-separator. Author (TAB)

N67-16484# Mitre Corp., Bedford, Mass.
STUDIES OF DISPLAY SYMBOL LEGIBILITY. PART XV: RELATIVE LEGIBILITY OF LEROY AND TELETYPEWRITER SYMBOLS
Glennis L. Bell Bedford, Mass., AFSC, Electron. Systems Div., Sep. 1966 80 p refs
(Contract AF 19(628)-5165)
(MTR-265; ESD-TR-66-316; AD-641926) CFSTI: HC $3.00/MF $0.65

The first two studies are reported from a planned series of studies to obtain legibility data on teletyped hourly sequence weather reports. In the first study, subjects were asked to identify symbols, shown singly in a random order with the symbols occurring with equal frequencies. The two teletype fonts, Murray and Long Gothic, were compared with a standard Leroy font. The second study used the teletype fonts only, and the subjects identified symbols shown with symbol frequencies similar to those in typical hourly sequence reports. For these experimental conditions, the teletype fonts were not as legible as the standard Leroy font although the symbol frequencies found in typical hourly sequence reports improved the subjects reading performances. Author (TAB)

N67-16643# Aerospace Medical Div. Personnel Research Lab. (6570th), Lackland AFB, Tex.
EVALUATION OF AIRMAN JOBS BY FOUR CATAGORIES OF RATERS
Joe T. Hazel and Douglas K. Cowan Jun. 1966 33 p refs
(PRL-TR-66-3; AD-640567) CFSTI: HC $3.00/MF $0.65

To investigate differences between rater groups in their evaluation of airman jobs, four groups of raters each evaluated a sample of 200 airman job descriptions. The groups consisted of senior NCOs, lieutenants, captains, and field grade officers. The jobs were evaluated in terms of merited grade, merited pay, and the relative importance of five job requirement factors. Within groups each job was evaluated by five raters and across all groups by 20 raters. The raters also indicated their confidence in the grade level ratings they made. The analyses used to compare the four groups were concerned with differences in means, distribution variability, and reliability of ratings and the predictive efficiency of the five job requirement factors. These analyses revealed two statistically significant ($P > .01$) differences among groups. The mean of the field grade officers expressed greater confidence in their assigned grade ratings than the other groups. However, the NCO difference seemed of little practical consequence, and there was agreement among the groups with regard to the reliability and homogeneity of assigned ratings, and the level of predictive efficiency of the five job requirement factors. The present findings support the use of a composite groups of raters to evaluate airman jobs. Author (TAB)

N67-16654# American Inst. for Research, Pittsburgh, Pa.
A REINFORCEMENT ANALYSIS OF GROUP PERFORMANCE
Robert Glaser, and David J. Klaus 1966 25 p refs *Its* Psych. Mon., General and Applied no. 621, v. 80, no. 13
(Contract Nonr-2551(00))
(AD-640624) Available from Am. Psychological Assoc., Inc., Washington, D. C.: $1.00

Two studies investigated response feedback and reinforcement contingencies occurring in a 'team environment.' Study I investigated 3-man series teams under conditions of response acquisition, extinction, spontaneous recovery, reacquisition and reextinction. Feedback to team members was based solely on group output. The results suggest team performance can be manipulated using methods which effectively control the behavior of individual organisms. Study II investigated 3-min parallel teams in which a reinforced team response could occur as a function of correct responding by only part of the team. With continued reinforced practice, performance degraded to a level equal to or below initial team performances. These findings are analyzed in terms of an operant conditioning model of team performance. Author (TAB)

N67-16660# Tufts Univ., Medford, Mass. Inst. for Psychological Research.
HUMAN FACTORS ENGINEERING BIBLIOGRAPHIC SERIES. VOLUME I: 1940–1950 LITERATURE
Paul G. Ronco Aberdeen Proving Ground, Md., Human Eng. Labs., May 1966 1642 p refs
(Contracts Nonr-494(13); DA-18-001-AMC-1004(X))
(AD-639906) CFSTI: HC $3.00/MF $0.65

The bibliography is the first in a planned series of bibliographies of literature pertinent to the field of human factors engineering. It covers literature from the time period of 1940 through 1959. The bibliography consists primarily of: (1) an index to the human factors literature, and (2) the annotated bibliography. Author (TAB)

N67-16661*# Stanford Research Inst., Menlo Park, Calif.
TACTUAL PERCEPTION: EXPERIMENTS AND MODELS
James C. Bliss, Hewitt D. Crane, Stephen W. Link, Phyllis K. Mansfield, James T. Townsend et al Washington, NASA, Jan. 1967 197 p refs
(Contracts NAS2-2752; AF 33(615)-1099)
(NASA-CR-623) CFSTI: HC $3.00/MF 0.65 CSCL 05H

Summarized are results from five different studies on tactual perception, involving airjet stimulators and a computer-controlled facility. Reported are experiments on the effect of display movement on tactile perception; temporal effects in spatial pattern recognition; spatial interaction and memory limitations; reaction time; and tracking with transient and continuous commands. Speculation is made concerning the usefulness of the basic research described in the development of new uses of the tactile channel. S.C.W.

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N67-15346# Idaho Univ., Moscow.
NEW HYPOFLUORITES CONTAINING NITROGEN Annual Report, 1 Oct. 1965–30 Sep. 1966
Jean'ne M. Shreeve 1 Oct. 1966 19 p refs
(Contract Nonr-4217(00); ARPA Order 442)
(AR-3; AD-640893) CFSTI: HC $3.00/MF $0.65

If 1.5 equivalents of NF_2CFO is allowed to react with a single equivalent of KF to form what is likely a mixture of $KOCF_2NF_2$ and $KOCF(NF_2)_2$, this mixture may be thermally decomposed without explosion to yield perfluoroures. When $KOCF(NF_2)_2$ is reacted with $SiCl_4$, a new volatile compound, $NF_2C(C1)O$ is obtained. $NF_2C(F)O$ gives $NF_2C(C1)O$ with $AlCl_3$. N,N-bis(trifluoromethyl) hydroxylamine forms a solid adduct with either CsF_2 or KF. The

adduct will react at room temperature with perfluoroacyl and carbonyl halides to give the corresponding bis(trifluoromethyl) nitroxo-compounds. Bis(trifluoromethyl)ketene is highly reactive with compounds that ordinarily add across olefinic double bonds, e.g., S2O6F2, N2F4, and NF2OSO2F. With the latter two, two isomers are obtained. Treatment with fluorine at −20C in the presence of CsF yields hypofluorites. A simple preparation of FNO was found which involves the reaction of nitrogen dioxide with KF or CsF. The conversion is about 48+%. This reaction may be carried out in metal or Pyrex glass vessels and the conversion rate is increased by heating. TAB

N67-15399* Whittaker Corp., Los Angeles, Calif. Narmco Research and Development Div.

SEPARATOR DEVELOPMENT PHASE OF HEAT-STERILIZABLE BATTERY DEVELOPMENT PROGRAM Final Report, 11 Jun. 1965–31 Aug. 1966

Floyd D. Trischler Oct. 1966 36 p refs Prepared for JPL (Contracts NAS7-100; JPL-951091)
(NASA-CR-81161) CFSTI: HC $3.00/MF $0.65 CSCL 07C

Aliphatic polybenzimidazoles, polybenzoxazoles, and polybenzothiazoles and polyquinoxalines were screened for their suitability as potential separator materials for a heat sterilizable silver–zinc battery. All of the polymers were extremely stable to alkaline hydrolysis but had an excessively high resistivity. The polybenzimidazoles were selected for further study based on their solubility and potential ease of chemical modification. Several attempts were made to reduce the resistivity of the polybenzimidazoles; these included the use of leachable additives, and polymer modifications such as sulfonation, N-hydroxyethylation and N-carboxyethylation. While leachable additives reduced the resistivity of the aliphatic polybenzimidazoles, they were unsatisfactory in providing films meeting the resistivity requirement of 150 ohm–cm maximum. The sebacic acid based polybenzimidazole was successfully sulfonated; but the polymer was insoluble in all common solvents. A sebacic acid based polybenzimidazole was N-hydroxyethylated and tested in film form. Author

N67-15435 United Kingdom Atomic Energy Authority, Springfields (England). Production Group.

A POTENTIOMETRIC, HIGH PRECISION, ASSAY METHOD FOR THE DETERMINATION OF URANIUM IN URANIUM METAL

1966 17 p Supersedes PG-663(S)
(PG-647(S); PG-663(S)) HMSO: 2s 6d

A portion of the sample is dissolved in orthophosphoric acid. Lower valency states of impurities and U^{III} are oxidised by aeration and an excess of potassium dichromate over that required to oxidise the tetravalent uranium is added. The excess potassium dichromate is then titrated potentiometrically using ferrous ammonium sulphate solution. Author

N67-15436 United Kingdom Atomic Energy Authority, Wantage (England). Research Group.

THE RADIATION-INITIATED CARBOXYLATION OF CYCLOHEXANE

P. R. Hills Sep. 1966 16 p refs Presented at the 3d Intern. Congr. of Radiation Res., Cortina D'ampezzo, Italy, Jun. 1966
(AERE-R-5236) HMSO: 2s 6d

In irradiated cyclohexane solution, oxalyl chloride reacts by a chain mechanism to afford the acid chloride cyclohexane carboxylic acid. No such reaction has been observed in cyclohexene solution. The G values varying from 200 to 750 are dependent on the concentration of oxalyl chloride but apparently independent of the dose rates employed. The data obtained can be expressed in the relationship: G value = kc^a, where c is the mole fraction of oxalyl chloride and the exponent, a, equals 0.69 ± 0.02. Author

N67-15533# Hanford Atomic Products Operation, Richland, Wash. Chemical Processing Dept.

PROCESSING AND SOURCE PREPARATION OF SEPARATED FISSION PRODUCTS

J. S. Cochran (Isochem., Inc.), S. J. Beard, and P. W. Smith *In* Du Pont Large Scale Production and Appl. of Radioisotopes May 1966 12 p refs (See N67-15525 06-22) CFSTI: HC $3.00/MF $0.65
(Contract AT(45-1)-1350)

Described is the recovery of fission products with the production of strontium-90 and cesium-137. The program included production of custom quantities of cerium-144 and promethium-147, and separation of strontium and rare earths from Purex acid waste by lead carrier sulfate precipitation and subsequent separation of rare earths from strontium by oxalate precipitation. Cesium-137 is recovered from aged alkaline wastes by processing the alkaline supernatant solution through a bed of alumino-silicate resin. Several other processes were demonstrated with process solutions in plant equipment. Cesium has been recovered from alkaline wastes by zeolite ion exchange and nickel ferrocyanide precipitation and from acid wastes by phosphotungstic acid precipitation. Technetium-99 has been recovered and purified by anion exchange. Cerium has been separated from the rare earths by di(2-ethylehexyl)phosphoric acid solvent extraction using silver catalyzed persulfate oxidation of cerium(III) to cerium(IV). Promethium-147 was subsequently separated from the cerium-free rare earths by chromatographic ion exchange. Author

N67-15534# Brookhaven National Lab., Upton, N. Y. Radiation Div.

CHEMONUCLEAR AND RADIATION CHEMICAL PROCESS RESEARCH AND DEVELOPMENT

M. Steinberg *In* Du Pont Large Scale Production and Appl. of Radioisotopes May 1966 28 p refs (See N67-15525 06-22) CFSTI: HC $3.00/MF $0.65

The guiding principles and some of the latest results of the development of nuclear energy for the synthesis and production of utility and industrial chemicals are presented. This work indicates that fissiochemonuclear processes for the fixation of nitrogen, synthesis of ozone, and production of synthesis gas (carbon monoxide and hydrogen) are sufficiently interesting from a long-term national goals point of view, to provide ample incentive for a continued orderly development of the science and technology of this field. Radiation-induced chemical processes using isotopic and machine sources for chain reaction products will continue attracting further industrial development efforts. Author

N67-15538# Japan Atomic Energy Research Inst., Tokyo.

PRESENT STATUS OF RADIATION CHEMISTRY RESEARCH IN JAPAN

E. Munekata *In* Du Pont Large Scale Production and Appl. of Radioisotopes May 1966 6 p (See N67-15525 06-22) CFSTI: HC $3.00/MF $0.65

The application in Japan of radiation chemistry to high-molecular chemistry for manufacturing purposes is summarized. Industrialization of radiation chemistry is promoted by an administration committee in cooperation with several university professors, individual enterprises, and public research institutes. Pioneer experimental work was on graft polymerization of fibers using EBG of 2 MeV as a radiation source. A cobalt-60 water-pool power reactor was used in experiments on high-purity ethylene gas and afforded powdery polyethylene. Laboratory research experiments are being conducted on oxidation of benzene in aqueous solution, and chlorination of hydrocarbon. Research exchange programs are also briefly mentioned. R.U.

N67-15557*# National Aeronautics and Space Administration, Washington, D. C.
TWO THREE-METAL CHEMICAL COMPOUNDS ($NaKHg_2$ AND NaCdHg) [UEBER ZWEI CHEMISCHE YERBINDUNGEN DREIER METALLE UNTER SICH ($NaKHg_2$ UND NaCdHg)]
Ernst Jaenecke Dec. 1966 5 p Transl. into ENGLISH from Z. Physik. Chem. (Frankfurt), v. 57, 1907 p 507–510
(NASA-TT-F-10444) CFSTI: HC $3.00/MF $0.65 CSCL 06B

The incomplete investigations show the discovery, in each of the two systems studied, of a chemical compound containing all three metals simultaneously. Cooling curves are presented with two constructed "reduced" cooling curves shown in the figure. The compounds and the compositions of each are summarized. Author

N67-15690*# National Aeronautics and Space Administration, Washington, D. C.
INTERACTION BETWEEN CARBIDES OF TRANSITION METALS AND THEIR OXIDES [VZAIMODYSTVIYE KARBIDOV PEREKHODNYKH METALLOV S IKH OKISLAMI]
T. Ya. Kosolapova, V. B. Fedorus Dec. 1966 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Neorganicheskiye Materialy (USSR), v. 2, no. 8, 1966 p 1516–1523
(NASA-TT-F-10447) CFSTI: HC $3.00/MF $0.65 CSCL 07B

Interaction between oxides of transition metals belonging to the IV–VI groups of the periodic system of elements is studied. The difference in interaction between oxides and carbides of these metals is due to the electron structure of atoms of metals producing the oxides and carbides. Author

N67-15724*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE REACTIONS OF CARBOXYL-TERMINATED PREPOLYMERS WITH POLYEPOXIDES AND POLYAZIRIDINES
S. H. Kalfayan and B. A. Campbell *In its* Space Programs Sum. No. 37–41, Vol. IV 31 Oct. 1966 p 113–115 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

A carboxyl-terminated liquid saturated aliphatic hydrocarbon polymer was evaluated in an effort to determine the degree of aging ascribed to oxidation and/or crosslinking at the sites of unsaturation. The unsaturation in the cured polymer was reduced by blending the poly(butadiene)-backboned prepolymers with saturated polybasic acids. Materials used included Empol 1010 which is a C_{36} dibasic acid containing 3.5% C_{54} tribasic acid; and DER 732 and DER 736 which are epoxy-terminated poly(alkylene oxides) with epoxide values of approximately 320 and 190, respectively. Presented are results of studies of the reaction of Empol 1010 with epoxides and aziridines, the reaction of a blend of Telagen CT and Empol 1010 with epoxides and aziridines, and the reaction of carboxyl-ending poly(butadienes) with epoxide-aziridine mixtures. S.C.W.

N67-15738*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE SIGNS OF FLOURINE–PHOSPHORUS COUPLING CONSTANTS
S. L. Manatt, D. D. Elleman, A. H. Cowley, and A. B. Burg *In its* Space Programs Sum. No. 37–41, Vol IV 31 Oct. 1966 p 180–181 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

The signs of certain phosphorus fluorine nuclear resonance spin–spin coupling constants are presented. Field sweep double resonance studies were performed on the following compounds: CF_3PH_2, $(CH_3)_2PH$, CF_3PF_2, $(CF_3)_2PF$, and $CF_3-P-P(CH_3)_2$. The relative signs were established from (1) interpretation of changes in the ^{31}P spectra in transitory selective irradiation experiments when either certain ^1H or ^{19}F lines were saturated, (2) tickling experiments, or (3) partial collapse of multiplet structures with a still larger H_2 field. The abolute signs and type of coupling are tabulated, and are based on the assumption that the sign of the directly bonded phosphorus–proton coupling is absolute positive. C.T.C.

N67-15741*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MOLAR EXTINCTION COEFFICIENTS OF HYDROGEN IODIDE IN THE SCHUMANN REGION
O. F. Raper and W. B. de More *In its* Space Programs Sum. No. 37–41, Vol. IV 31 Oct. 1966 p 189–191 refs (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

The spectral characteristics of hydrogen iodide in the 2000- to 3000-Å region were investigated to obtain accurate extinction coefficients necessary for actinometric determinations and for theoretical consideration of the electronic states of HI involved in radiation absorption. The experimental apparatus is described, and graphs of the observed optical density of HI at 2220 Å and the molar extinction coefficients for HI are shown. Although none of the values reported here are in agreement with those reported earlier by Romand, it is noted that the excellent agreement between these results and those of Gordus and White tend to indicate that these data can be used with confidence. A.G.O.

N67-15768 United Kingdom Atomic Energy Authority, Harwell (England). Chemical Engineering Div.
THE PERMEABILITY OF NUCLEAR GRADE GRAPHITE TO A VARIETY OF GASES
G. F. Hewitt, M. J. C. Moore, and E. W. Sharratt Sep. 1966 28 p refs
(AERE-R-3994) HMSO: 3s

An apparatus is described for the measurement of gas permeability of nuclear grade graphite. This apparatus was used to measure the permeability of several specimens to a variety of gases (argon, helium, hydrogen, oxygen and nitrogen). The permeability coefficients (B_0 the viscous permeability, and K_0 the slip flow coefficient) were found to be similar for all the gases for any particular specimen, but the differences are significant compared to the experimental error. Author

N67-15776 Library of Congress, Washington, D. C. Aerospace Technology Div.
ORGANIC SEMICONDUCTORS Surveys of Foreign Scientific and Technical Literature
Serge Markov 30 Jun. 1966 59 p refs
(ATD-66-84)

The subject of this report is Soviet research on the electrical properties of organic semiconductors and photoconductors. Material has also been included dealing with the preparation of such products, known or potential, and with their structure, morphology, and magnetic properties insofar as these are associated with electrical properties. The present report concludes the topic of polymers with a continuous system of double bonds in the backbone. It covers polyarylenes, polyazoarylenes, polyazines, polymeric Schiff bases, polymers with pyridinyl, vinyl, and phenyl groups in the backbone, "onium" polymers, and aniline black and similar substances. The introduction includes a table listing the materials prepared, the preparative routes used, the scientists involved, their associations and the appropriate entry numbers. A bibliography is included. Author

N67-15803*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY OF DERIVATIVES OF TRIFLUOROMETHYLSULFENYL CHLORIDE
D. D. Lawson and J. D. Ingham *In its* Space Programs Sum. No. 37–40, Vol. 4 31 Aug. 1966 p 93–95 (See N67-15781 06-34) CFSTI: HC $3.00/MF $0.65

The F^{19} chemical shifts of trifluoromethylsulfenyl chloride reaction products at 56.4 MHz in carbon tetrachloride solvent with $BrCF_2CF_2BR$ reference are depicted. Although most of the spectra showed some contamination of the esters by undetermined side products and the shifts from the reference are relatively inexact, it is pointed out that products of primary and tertiary hydroxyls show strong NMR signals that are nominally separated

by 1400 to 100 HZ, respectively, from the secondary in a field of 14,000 gauss at an oscillator frequency of 56.4 MHz. These separations are approximately 100 times those observed previously for the corresponding trifluoroacetates. These preliminary results indicate that sulfenyl chloride can be advantageously employed to obtain products with large F^{19} chemical shift differences for primary, secondary, and tertiary hydroxyl compounds, and compounds or polymers containing several different types of reactive groups.
M.G.J.

N67-15804*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE REACTION OF CARBOXYL AND AMINO TERMINATED PREPOLYMERS WITH POLYEPOXIDES
S. H. Kalfayan and B. A. Campbell *In its* Space Programs Sum. No. 37-40, Vol. 4 31 Aug. 1966 p 95-98 refs (See N67-15781 06-34) CFSTI: HC $3.00/MF $0.65

Experiments on the catalysis of the barcoxyl–epoxide reaction are briefly described, along with studies on the homopolymerization of the epoxides, with and without catalysts. Gel times and Shore A hardnesses are tabulated for carboxyl and amino-ending prepolymers cured with four epoxides. Compared with the carboxyl–aziridine reaction, the carboxyl–epoxide reaction is found to be much slower. Data on the homopolymerization of epoxides show that both uncatalyzed and acid catalyzed homopolymerization rates are slower than the rate of the carboxyl–epoxide reaction. However, tertiary amine (benzyldimethylamine) catalyzed homopolymerizations are fast and can be competing reactions. Summarized test data for the catalysis of the carboxyl–epoxide reaction are also presented. A brief report is included on the effect of thermal sterilization on carboxyl- and amino-terminated prepolymers cured with epoxides.
M.G.J.

N67-15831*# Whittaker Corp., San Diego, Calif. Narmco Research and Development Div.
ELECTROCHEMICAL CHARACTERIZATION OF SYSTEMS FOR SECONDARY BATTERY APPLICATION Second Quarterly Report, Aug.–Oct. 1966
M. Shaw, N. K. Gupta, A. H. Ramanick, and R. J. Radkey 18 Nov. 1966 116 p refs
(Contract NAS3-8509)
(NASA-CR-72138) CFSTI: HC $3.00/MF $0.65 CSCL 07D

Multisweep cyclic voltammograms have been obtained for systems comprising silver, copper, nickel, zinc, cadmium, and molybdenum in acetonitrile, butyrolactone, dimethylformamide, and propylene carbonate solutions of chlorides and fluorides. Voltammograms are presented for 56 of these systems. Tabular data include peak current density, sweep index, charge–discharge efficiency, and discharge capacity.
Author

N67-15980# California Inst. of Tech., Owens Valley Radio Observatory.
THE RADIO SOURCE 3C 17
A. T. Moffett, M. Schmidt, C. H. Slater (Nuffield Radio Astronomy Labs.), and A. R. Thompson (Stanford Univ.) 1966 8 p refs Submitted for Publication
(Contract N00014-67-A-0094-0008; N62558-3624)
(Rept.-101966; AD-642166) CFSTI: HC $3.00/MF $0.65

The position of the radio source 3C 17 is derived from 9 occultation events recorded at three observatories. The positional accuracy is about 0.5 second, and a 19th magnitude galaxy is found within 1 second of the radio position. Occultation and interferometric measurements indicate that the source is probably of the cornehalo type, with a maximum diameter of 20-30 seconds. The optical spectrum of the galaxy shows emission lines typical of other radio galaxies, thus confirming the identification: the redshift is 0.2201.
Author (TAB)

N67-16034# General Electric Co., Schenectady, N. Y. Research and Development Center.
MECHANISM OF SILICON OXIDATION
R. N. Hall *In its* New Solid-State Device Concepts Sep. 1966 p 31-33 refs (See N67-16029 06-26) CFSTI: HC $3.00/MF $0.65

The roles played by the various ionic and electronic species that migrate through the SiO_2 during the excitation of silicon are discussed in relation to the uncertainties that exist concerning these phenomena. Three areas are recommended for further study: the theoretical cell potential, the charge state of an ion as it moves across the oxide, and the spatial origin of the cell emf.
M.G.J.

N67-16039# Pennsylvania State Univ., University Park. Materials Research Lab.
CRYSTAL CHEMISTRY STUDIES Quarterly Report, 14 May–13 Aug. 1966
Oct. 1966 16 p refs
(Contract DA-28-043-AMC-01304(E))
(ECOM-01304-5; QR-5; Rept.-5; AD-640952) CFSTI: HC $3.00/MF $0.65

Additional measurements on the rare-earth rhenium oxides were made. The resistivity (approx. 20,000 ohm-cm) and evidence of some photoconductivity were found for single crystal Beta-Nd2ReO5. The densities of Yb2ReO5 (9.79 g/cc) and Beta-Nd2ReO5 (8.14 g/cc) were measured. The systems MoO3-ReO3 and WO3-ReO3 were examined with the conclusion that no solid solution exists between these components. An attempt at single crystal growth of ReO3 was unsuccessful. Systematic work was started in the system EuO-Eu2O3-TiO-TiO2. The compounds EuTiO3, Eu2Ti2O7, and a new compound Eu2TiO5 (possibly) have thus far been detected. Additional runs have been made in the systems MgO-Cr2O3-O, CdO-Cr2O3-O, and NiO-Cr2)3-O. High oxygen pressure studies of the system Cr-Fe-O have been resumed.
Author (TAB)

N67-16043*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TABLES OF THERMIONIC PROPERTIES OF THE ELEMENTS AND COMPOUNDS
Kenneth Carr (Rose Polytech. Inst.) Washington, NASA, 1967 34 p refs
(NASA-TM-X-52263) CFSTI: HC $3.00/MF $0.65 CSCL 07D

For emission physics utilization, the thermionic and electric properties of solid and liquid elements and compounds are tabulated. Data cover: absorption heat, electric dipole moments, electronic polarizability, emission properties minimum effective work functions, selected vapor pressures, and desorption energies. An extensive bibliography is included.
R.I.J.

N67-16049* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EFFECT OF MOLECULAR STRUCTURE ON PHYSICAL CHARACTERISTICS OF POLYARYLOXY SILANES AND RELATED COMPOUNDS
Mary H. Fowler 14 Nov. 1966 54 p refs
(NASA-TM-X-53536) CFSTI: HC $3.00/MF $0.65 CSCL 07C

In continuing studies of the thermal stability of polyaryloxysilanes, several new monomeric compounds of the structure, $(CH_3)_3SiOROSi(CH_3)_3$ were prepared in which R was derived from 4,4'bis (hydroxymethyl) diphenylether, and the aromatic diols of diphenylsulfone, diphenylether, diphenyldimethylmethane, diphenylmethane, benzophenone, and 1,2-bis(p-phenyl)-1,2-diethylethylene. Fractional distillation of these compounds, followed by hydrolysis, provided a convenient means for purifying the starting aromatic diols. The purified diols were employed in reactions with bis (anilino) diphenylsilane yielding diphenylary-loxysilane polymers, $[Si(C_6H_5)_2ORO]_n$ which possessed relatively

high thermal resistance. Similar polymers were also prepared from the aromatic diols 4,4'-dihydroxyazobenzene and 3,4-bis(p-hydroxyphenyl)-2,4-hexadiene which were not purifed by this technique.
Author

N67-16074# Explosives Research and Development Establishment, Waltham Abbey (England).
A RADIOCHEMICAL TECHNIQUE TO STUDY THE SOLVENT TRANSFER REACTION IN THE POLYMERISATION OF TETRAHYDROFURAN BY PHOSPHORUS PENTAFLUORIDE
D. H. Richards, D. A. Salter, and D. Sims 13 Jun. 1966 13 p refs
(ERDE-4/M/66; WAC/174/04; AD-641309) CFSTI: HC $3.00/MF $0.65

A radiochemical technique using 14C-labelled diethyl ether was used to prove that a chain transfer reaction to solvent occurs during the polymerisation of tetrahydrofuran by phosphorus pentafluoride. A mechanism to describe the chain transfer reaction was suggested.
Author (TAB)

N67-16129# Cornell Univ., Ithaca, N. Y. Dept. of Chemistry.
ELECTRIC FIELD EFFECT ON THE CRITICAL OPALESCENCE. II: RELAXATION TIMES OF CONCENTRATION FLUCTUATIONS
Peter J. W. Debye, Claude C. Gravatt, and Masayuki Ieda 15 Nov. 1966 22 p refs Submitted for Publication
(Contract Nonr-401(58))
(TR-1; AD-642606) CFSTI: HC $3.00/MF $0.65

In an investigation of the effect of electrical fields on the critical opalescence, time dependent phenomena were observed which are related to theoretical relaxation times of concentration fluctuations for a binary mixture. Rectangular DC pulses of 25 to 60 Kvolt/cm and 10 to 200 microsec. duration were applied to a critical mixture of nitrobenzene and 2,2,4-trimethylpentane at a series of temperatures above the critical solution temperature. Relaxation times associated with the change in the transmitted light intensity were found to be independent of the pulse width and the field strength. The relaxation times are proportional to (T - Tc) to the -0.9 power and have magnitudes comparable to relaxation times determined from the frequency broadening of light scattered from similar binary systems. It was also possible to extend the agreement between the Debye theory and the experimental results to within 0.1C of Tc.
Author (TAB)

N67-16135# Ohio State Univ. Research Foundation, Columbus.
THE LOW FREQUENCY REGION OF THE INFRARED SPECTRUM OF MATRIX ISOLATED VAPORS FROM $Li_2O(S)$+
D. E. Mann (ARPA), K. S. Seshadri, and David White Sep. 1966 15 p refs
(Contract Nonr-495(12))
(TR-5A; AD-640966) CFSTI: HC $3.00/MF $0.65

The infrared spectrum of matrix isolated vapors from solid Li2O has been investigated on the region 80 - 350/cm. At 1640K, where the polyatomic species Li2O(g) predominates, a single feature is found at 118/cm for Li2(7)O(g) and 112/cm for Li2(6)O(g). This is assigned to the bending mode nu sub 2. At higher temperatures, 1740K, where the concentration of Li2O2(g) becomes significant, two additional bands are found. On the basis of Li(6)-Li(7) isotopic shifts and relative intensities, it is possible to identify the bands in the region 240-260/cm with the B sub lu out of plane mode of Li2O2(g) and those at 231-243/cm to nu sub 2 of a new molecular species LiO2(g). A force constant analysis is given. On the basis of the present work it has been concluded that Li2O is most probably linear and LiO2 symmetric and nearly linear.
Author (TAB)

N67-16137# Picatinny Arsenal, Dover, N. J. Pyrotechnics Lab.
NEW FLARE FORMULATIONS FOR HIGH ALTITUDE APPLICATION
James A. Carrazza, Jr., Bossie Jackson, Jr., and Seymour M. Kaye Oct. 1966 24 p refs
(PA-TR-3360; AD-641957) CFSTI: HC $3.00/MF $0.65

A comparison of various fuels, such as atomized magnesium, zirconium, hafnium, magnesium-barium alloy, and magnesium-strontium alloy, under ambient and simulated high altitude conditions has been conducted. The metal powders were evaluated in binary formulations using sodium nitrate oxidant. Kraft paper tubes having a 0.625 inch ID and 0.0625 inch wall thickness were used as test vehicles. Data analyses indicated that all the formulations containing the various fuels sustained significant decreases in candlepower and burning rate in the transition from ambient pressure to reduced pressure simulating various altitude levels. Only the formulations containing zirconium and hafnium were tested at a simulated altitude of 100,000 feet. The data obtained for the alloy-containing compositions at 80,000 feet did not justify further evaluations at 100,000 feet simulated altitude. At simulated altitudes of 80,000 feet and lower, the powdered zirconium and some of the alloy-containing systems were observed to be superior to those formulations containing atomized magnesium. The systems which contained magnesium-barium alloy were found to be superior to the magnesium-strontium and the mixed alloy formulations under reduced pressure conditions. The data generated for the hafnium/sodium nitrate formulation at simulated altitudes of 80,000- and 100,000 feet was not considered reliable since the light output was below the sensitivity of the instrumentation.
Author (TAB)

N67-16150# Cornell Univ., Ithaca, N. Y. Dept. of Chemistry.
THE BEHAVIOR OF NON-IONIC DETERGENTS IN NON-POLAR SOLVENTS Final Report, 1 Nov. 1955–1 Jun. 1966
Claude C. Gravatt and Peter J. W. Debye 15 Nov. 1966 9 p refs
(Contract Nonr-401(17))
(AD-642604) CFSTI: HC $3.00/MF $0.65

A summary is given of investigations conducted during the period November 1, 1955 to June 1, 1966 on the behavior of non-ionic detergents in non-polar solvents and which employed the techniques of light scattering, dielectric constant measurements, viscosity measurements, and dynamic vapor pressure determinations. A list of reports and publications generated as a result of the contract is included.
TAB

N67-16152# Franklin GNO Corp., West Palm Beach, Fla.
INVESTIGATION OF ELECTRON ATTACHMENT CHARACTERISTICS OF SPECIFIC CANDIDATE MATERIALS IN ATMOSPHERIC AIR Technical Summary Report, 3 May 1965–1 Aug. 1966
Robert W. Crowe 15 Aug. 1966 59 p refs
(Contract Nonr-4977(00))
(Rept.-266; AD-640953) CFSTI: HC $3.00/MF $0.65

A method was developed for detection of certain undesirable materials in the atmosphere. The method relies on the fact that most undesirable materials have strong affinities for free electrons of thermal energy. The complete apparatus consists of a high vacuum system, a mechanically pulsed ultraviolet light source, a mechanically driven magnetic pickup head with associated electronics for providing the pulsing sequence desired, and an attachment drift chamber. The latter consists of a photocathode, several guard rings to insure a uniform electric field, a control grid, and a collector anode whose current is read by means of an electrometer. The magnitude of the current as a function of time, provides the necessary information regarding electron attachment by the constituents present in the atmosphere. The simulant candidate materials dimethyl hydrogen phosphite and trimethyl phosphite were examined in the drift chamber and found to be detectable at concentrations down to less than one part in 1 million. Using a continuous flow technique, Sarin was introduced into the drift chamber at a concentration of one part in 1 million and detected

through the production of negative ions by electron capture. The method should be feasible for the detection of other toxic materials in the atmosphere at low concentrations. Author (TAB)

N67-16155# Cornell Univ., Ithaca, N. Y.
ELECTRON DIFFRACTION STUDIES AT ELEVATED TEMPERATURES Annual Report
Simon H. Bauer, L. Hencher, G. H. Lee, and H. Oberhammer Oct. 1966 48 p
(Contracts ARPA SD-68; Nonr-092-504; Grant NSF GP-4291; ARPA Order 23-63)
(AD-641659) CFSTI: HC $3.00/MF $0.65

When a sample under investigation is illuminated by parallel rays, and suitable lenses are available for the radiation used, the resulting scattering (i.e. diffraction) pattern can be focused onto a plane. Then the spacing of the diffraction maxima and minima is determined by the characteristics of the projection lens and is independent of the location of the sample. An electron diffraction apparatus for gases operating on this principle is not limited by the loss of resolution due to sample spread, nor by the departure of the photographic plate from the focal sphere, as are units of conventional design. An apparatus built on the parallel incidence principle has features which are particulatly advantageous for samples which are available at low densities only, and for studies of surface reflections at grazing incidence. The author reports that during the past year the apparatus under construction since 1963, was brought into operation, and demonstrated that the apparatus operates essentially as predicted. TAB

N67-16158# California Univ., Santa Barbara. Dept. of Chemistry.
EFFECTS OF HIGH PRESSURES ON THE ABSORPTION SPECTRUM OF AZOBENZENE
A. H. Kadhim and H. W. Offen 18 Oct. 1966 3 p refs
(Contract N00014-66-C0019-A01)
(TR-1; AD-641575) CFSTI: HC $3.00/MF $0.65

The effects of high pressures (0-25 kbar) on the near ultraviolet and visible absorption spectra of trans-azobenzene were studied. Azobenzene was dispersed in six different polymer matrices and compressed in an optical cell at room temperature. The magnitude and direction of the spectral shift depend upon the type of transition (n-pi* vs. pi-pi*), the nature of the polymer matrix, and other specific interactions whose relative importance are not easily ascertained. The n-pi* band showed a blue shift in a hydroxylic polymer at the highest pressure. The intensity of the pi-pi* band was unaffected by compression while the n-pi* band strength increased significantly. Such enhancement could result from partial removal of its symmetry-forbiddenness or greater intensity stealing from the pi-pi* transition at higher pressures. Author (TAB)

N67-16219# Maryland Univ., College Park.
CHEMICAL RESEARCH ON POLYPHENYLS Interim Report
G. Forrest Woods Wright-Patterson AFB, Ohio, ARL, Jul. 1966 58 p refs
(Contract AF 33(615)-2710)
(ARL-66-0144; AD-641975) CFSTI: HC $3.00/MF $0.65

An investigation is reported aimed at the synthesis of ring polyphenyls (polyphenylenes). One is a ring of five phenylene groups, and the other is the all-meta-six phenylene compound. Related to this work was a study of selective Grignard reagent preparation from substances containing two or three bromine atoms. The preparation of 1-(1-cyclohexenyl)-4-(1,3-cyclohexadienyl) benzene almost been completed. The intent is to learn whether unsaturation may go across a benzene nucleus, such that in the above substance 4-cyclohexylbiphenyl will result. Reported also is (1) the work on the utilization of the reaction of calcium carbide with ketones whereby acetylenic glycols are obtained. These glycols can then be converted to substituted 1,3,5-hexatrienes and on to p-polyphenyls; (2) the elimination (dehydration) reaction of ketones in the vapor state over alumina. Author (TAB)

N67-16221# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
NUKLEONIKA, VOLUME VIII, 1963
1966 907 p refs Transl. into ENGLISH of Nukleonika (Warsaw), v. 8, no. 1–12, 1963 p 1–856 Published for AEC and NSF
(AEC-TR-4919) CFSTI: HC $3.00/MF $0.65

Articles on neutron activation analysis, trace element determination, reactor instrumentation and technology, and experimental investigations in nuclear physics and chemistry are presented. For individual titles see N67-16222–N67-16324.

N67-16224# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
THE MECHANISM OF THE CATHODE PROCESS IN THE PREPARATION OF THORIUM–ZINC IN ALLOYS FUSED SALTS. IV: THE RELATION BETWEEN THE ZnF_2% IN THE ELECTROLYTE AND THE Zn% IN THE ALLOY AND THE MECHANISM OF THE CATHODE PROCESS
W. Rafalski and S. Minc *In its* Nukleonika, Vol. VIII 1966 p 40–54 refs (See N67-16221 06-08) CFSTI: HC $3.00/MF $0.65

The relation between ZnF_2% in the electrolyte and Zn% in the alloy was found during the electrolytic production of Th–Zn alloys from fused salts, consisting of ThF_4, CaF_2 and ZnF_2. The process temperature was maintained at 1100°C and the current was 13 amp ($d_k \cong 6$ amp/cm^2). A mechanism is proposed for the cathode process taking place. Author

N67-16225# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
OPTIMAL IRRADIATION AND MEASUREMENT CONDITIONS IN ACTIVATION ANALYSIS. γ-SPECTROMETRIC DETERMINATION OF TRACE CONTAMINATION IN THE PRESENCE OF AN ACTIVE MATRIX [O DOBORZE OPTYMALNYCH WARUNKOW NAPROMIENIOWANIA I POMIAROW W ANALIZIE AKTYWACYJNEJ. PRZYPADEK γ-SPEKTROMETRYCZNEGO OZNACZANIA SLADOWYCH ZANIECZYSZCZEN W OBECNOSCI AKTYWNOSCI MATRYCY]
S. Sterlinski *In its* Nukleonika, Vol. VIII 1966 p 55–65 refs (See N67-16221 06-08) CFSTI: HC $3.00/MF $0.65

In cases where the matrix activity disappears much more slowly than the activity of the trace isotope, it is considered more reliable to determine the number of pulses from the radiation of the trace isotope by two measurements of the sample: directly after irradiation, and after extinction of the activity of the trace isotope. A formula is given for the relative statistical fluctuation in the number of counts due to the activity of the trace element, and conditions are described for optimal irradiation and measurement of a sample. M.G.J.

N67-16226# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
A RAPID METHOD FOR THE DETERMINATION OF CESIUM-137 IN WATER AND URINE
J. Derecki, J. Geisler, D. Janković, and Zb. Jaworowski *In its* Nukleonika, Vol. VIII 1966 p 66–72 refs (See N67-16221 06-08) CFSTI: HC $3.00/MF $0.65

Ammonium molybdophosphate was used as a sorbent for determination of Cs-137 in water and urine. The method is selective in presence of several nuclides; calculations show 2.2×10^{-9} μc and 5.1×10^{-8} μc of Cs-137 in 200 ml water and urine samples respectively. Author

N67-16228# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

THE USE OF THE ^{110}Ag ISOTOPE FOR INVESTIGATIONS OF THE SOLUBILITY OF METALLIC SILVER AND SILVER CHLORIDE IN AQUEOUS ZINC SULFATE [ZASTOSOWANIA IZOTOPU ^{110}Ag DO BADANIA ROZPUSZCZALNOSCI SREBRA METALICZNEGO I CHLORKU SREBRA W ROZTWORACH WODNYCH SIARCZANU CYNKU]

J. Dobrowolski and J. Oglaza *In its* Nukleonika, Vol. VIII 1966 p 75–76 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The Ag^{110} isotope, with a half-life of 270 days, was used in the form of a carrier solution of $AgNO_3$. Water distilled twice in a quartz apparatus was used to make the aqueous solutions; the 0.01 N silver nitrate solutions for diluting the initial active solution were prepared from chemically pure silver nitrate, previously recrystallized. The precise titer of the standard solution was determined by titration of $AgNO_3$ with ammonium rhodanate. Chemically pure $ZnSO_4$ was used to make the series of aqueous solutions of zinc sulfate. The solubility of AgCl and metallic silver was measured in zinc sulfate solutions and in pure water as the mean result of three determinations for each medium. Numerical data are tabulated, and it is shown that the solubility of silver chloride in zinc sulfate solutions grows as the concentration of the solution increases; the solubility of metallic silver at first increases as the concentration of the zinc sulfate solution increases, and then diminishes. M.G.J.

N67-16229# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

EQUIPMENT OF PREPARING PHOSPHORS IN THE FLUORIMETRIC DETERMINATION OF URANIUM [URZADZENIE DO PREPAROWANIA STOPOW PRZY FLUOROMETRYCZNYM OZNACZANIU URANU]

H. LEWANDOWSKI *In its* Nukleonika, Vol. VIII 1966 p 79–81 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

A brief description is given of an open gas furnace which permits simultaneous fusing of 16 tablets, 25 mm in diameter, under identical, reproducible conditions. The principle of its operation consists of the fusing being carried out on a rotating plate over a number of gas burners. Author

N67-16233# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

ANHYDROUS URANYL NITRATE [BEZVODNYI URANILNITRAT]

B. Jezowska-Trzebiatowska and B. Kedzia *In its* Nukleonika, Vol. VIII 1966 p 98–111 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

Anhydrous uranyl nitrate obtained by G. Gibson's and J. J. Katz's modified method has been synthesized, with UO_3 and N_2O_4 being used. Apparatus is proposed for the synthesis. The absorption spectra of anhydrous uranyl nitrate in several organic solvents were obtained. The occurrence of the electronic-vibrational structure in these spectra is confirmed. As in the spectra of uranyl nitrate hydrates, the ten absorption bands in the range 360–500 mμ were identified here. The force constants (kU_{-O}=4.144 to 4.591)$\times 10^{-5}$ dyne/cm, interatomic distances rU_{-O}=1.81 to 1.84 Å and dissociation energy D=3.47 ev of the uranyl entity in the excited state have been calculated. The oscillator strengths are given. Electronic transitions in absorption spectra of uranyl nitrate have been identified in the visible range (about 22,000 cm^{-1}, 24,000 cm^{-1} and 27,000 cm^{-1}) as electronic transitions inside the molecular orbitals of the uranyl entity and in the ultraviolet range (27,000 cm^{-1}) as a transition from ligands to uranyl. The solubility of uranyl salts is limited mainly by dipole–dipole interaction and the covalency of binding in uranyl salts. Author

N67-16234# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

PRIMARY PROCESSES OF RADIATION CHEMISTRY AS STUDIED BY MASS SPECTROMETRY. I: FRAGMENTATION OF TETRAHYDRONAPHTHALENE ON ELECTRON IMPACT

Zb. Kecki and H. Wincel *In its* Nukleonika, Vol. VIII 1966 p 112–121 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

Mass spectrum of tetrahydronaphthalene has been registered. On the basis of the apparent masses of metastable ions, a scheme of tetrahydronaphthalene molecular fragmentation occurring under electron impact, was established. Great abundances of $C_nH_n^+$ ions, were observed. The $C_8H_8^+$ and $C_7H_7^+$ ions have a cyclic form and decompose in a similar way as the same ions originating from different organic substances. Author

N67-16235# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

THE INFLUENCE OF HYDROGEN ATOMS AND HYDROXYL RADICALS IN THE SPHERE OF ELECTRIC DISCHARGES ON THE ALUMINUM SURFACE CONDITION

A. Malinowska and W. Lange *In its* Nukleonika, Vol. VIII 1966 p 122–130 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The influence of various substances in the sphere of electric discharge on the aluminum surface by means of a breakdown voltage method has been examined. In the presence of hydroxyl radical acceptors HCOOH, CH_3COOOH the breakdown potential was decreasing. In the presence of water, H_3PO_4 and H_2O_2, thanks to the oxidizing effect of the radicals OH, the breakdown potential was increasing i.e. the surface was becoming more passive. Author

N67-16239# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

THE RADIATION INDUCED OXIDATION AND REDUCTION REACTIONS OF IRON IN AQUEOUS SOLUTIONS. III: THE REDUCTION OF Fe(III) IONS IN PERCHLORIC AND SULPHURIC ACIDS.

R. Broszkiewicz and S. Minc *In its* Nukleonika, Vol. VIII 1966 p 146–152 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The reduction of ferric ions in solutions of perchloric and sulphuric acids in concentrations 10^{-3} N or 10^{-1} N in the presence of isobutyl alcohol used as an acceptor of OH radicals has been investigated. The effects of the structure of ferric complexes is discussed. A mechanism of reduction reactions of ferric ions by the formed organic radicals is proposed. Author

N67-16240# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

THE RADIATION INDUCED OXIDATION AND REDUCTION REACTIONS OF IRON IN AQUEOUS SOLUTIONS. IV: THE REDUCTION OF Fe(III) IONS IN PERCHLORIC AND SULPHURIC ACIDS SOLUTIONS.

R. Broszkiewicz and S. Minc *In its* Nukleonika, Vol. VIII 1966 p 153–162 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The reduction of ferric ions in solutions of perchloric and sulphuric acids in concentrations 10^{-3} N or 10^{-1} N under the pressure of hydrogen 100 atm has been investigated. It was confirmed that in solutions of the 10^{-3} M acids $G_{Fe^{2+}}$ amounted to 3.0 for both solutions. In the solution of 10^{-1} N $HClO_4$ $G_{Fe^{2+}}$=2.51 and in 10^{-1} N H_2SO_4 $G_{Fe^{2+}}$=1.04. The results have been discussed in respect of the competitive reactions $Fe^{3+}+H_2O^- = Fe^{2+}+H_2O$ and $H_2O^-+H^+ = H_2O+H$ and the ratios k_6/k_6, for the given solutions, have been calculated. It was observed that ferric ions are reduced by the H_2O^- when the H atoms act as oxidants of the ferrous ions. The reducible form of ferric ions is the $FeOH2^+$ complex when Fe^{3+} and $FeSO_4^+$ ions are resistant to the radiation induced reduction. Author

N67-16245# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

A METHOD OF DETERMINING TRACE CHLORIDE ION CONTENTS IN THE WATER OF A REACTOR'S PRIMARY COOLING CIRCUIT [METODA OZNACZANIA SLADOWYCH ZAWARTOSCI JONOW CHLORKOWYCH W WODZIE PIERWOTNEGO OBIEGU CHLODZENIA REAKTORA]

T. Zielinska *In its* Nukleonika, Vol. VIII 1966 p 188–190 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

Of the known methods of determining chlorine in water the one chosen was the intermediate method for colorimetric determination of trace quantities of chlorides by means of diphenyl carbazone and mercuric nitrate. This method is based on the phenomenon of chloride ions being bound by mercury ions added in surplus with a very weakly dissociated mercuric chloride being formed; the surplus of Hg^{2+} ions is determined colorimetrically by means of their reaction with diphenyl carbazone. Author

N67-16248# Polish Academy of Sciences, Warsaw Committee for the Peaceful Uses of Nuclear Energy.

PRIMARY PROCESSES IN RADIATION CHEMISTRY AS STUDIED BY MASS SPECTROMETRY. II: THE STRUCTURE OF $C_7H_7^+$ AND $C_8H_8^+$ IONS FROM TETRAHYDRONAPHTHALENE IN THE GAS PHASE

H. Wincel and Z. Kecki *In its* Nukleonika, Vol. VIII 1966 p 198–206 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The appearance potentials of the $C_7H_7^+$ and $C_8H_8^+$ ions derived from tetranaphthalene by electron impact have been measured. The heats of formation of these ions were estimated. Basing on the energetic considerations it is suggested that $C_7H_7^+$ at the A.P. threshold as well as at a higher energy has the symmetrical tropylium structure. In the case of $C_8H_8^+$ the structure at the A.P. threshold is that of styrene and/or o-quinodimethane, but at the threshold of decomposition it is that of cyclooctatetraene ion. Author

N67-16249# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

ION EXCHANGE SORPTION OF URANIUM ON PEATS FROM DILUTE SOLUTIONS

K. Majchrzak *In its* Nukleonika, Vol. VIII 1966 p 207–212 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The practicability of sorption of uranium from solutions of the concentrations of 1 g/l and 1 mg/l on peat was investigated. The exchange capacity of peat was found to depend on the pH of the solution and on the complexing of the uranyl cation. Sorption maximum is at pH 4–5. Complexing ions depress markedly the exchange capacity of peat. Sorption of uranium from the mine waters on peat was found to be practicable. When mine water, acidified to pH 4.5 is passed through peat its uranium concentration falls below 0.01 mg/l. Hydraulic resistance of peat was minimized by the use of horizontal-flow exchange apparatus. Author

N67-16250# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

APPLICATION OF THE GUTZEIT METHOD TO RADIOCHEMICAL DETERMINATION OF ARSENIC. II: DETERMINATION OF ARSENIC IN SEMICONDUCTOR-GRADE GERMANIUM, SULPHUR AND MINERAL ACIDS

A. Foldzinska and J. Malinowski *In its* Nukleonika, Vol. VIII 1966 p 213–216 refs (See N67-16221 06-06 CFSTI: HC $3.00/MF $0.65

Methods are given for the determination of arsenic in semiconductor-grade germanium, sulphur and mineral acids by neutron activation, using separation by the Gutzeit procedure. The advantages of the method are: high sensitivity, no concentration of acids before analysis needed (avoiding thus possible contamination), simplicity of operations, good reproducibility and independence from the influence of impurities in the reagents on analysis results. Author

N67-16251# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

DIPOLE MOMENT OF TRIBUTYL PHOSPHATE [MOMENT DIPOLOWY FOSFORANU TROJBUTYLOWEGO]

J. Michalczyk *In its* Nukleonika, Vol. VIII 1966 p 217–223 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The dipole moment of tributyl phosphate (TBP) was determined by various methods. The dielectric constant μ, the refractive index for sodium light, and density of diluted TBP solutions in CCl_4 were investigated and a value of 3.01 D was obtained for μ by extrapolation. Measurements by the Onsager–Böttcher methods for pure liquid TBP gave a value of 3.28 D for μ. Syrkin's formula gave a somewhat higher value of 3.37 D for μ. A value of 2.0 was determined experimentally for Kirkwood's coefficient. This leads to the conclusion that in pure TBP there are bimolecular associates in which both dipoles have the same direction. A formula resulting from the Onsager and Böttcher theorem was used to calculate the TBP dipole moment from the values of dielectric constant, density and refraction index for sodium light of TBP mixed with a small quantity of water. Author

N67-16252# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

SEPARATION OF PROTACTINIUM FROM THORIUM BY REVERSED-PHASE PARTITION CHROMATOGRAPHY [VYDELENIE PROTAKTINIYA IZ TORIYA METODOM RASPREDELITEL'NOI KHROMATOGRAFII S OBRASHCHENNYMI FAZAMI]

I. Fidelis, R. Gwozdz, and S. Siekierski *In its* Nukleonika, Vol. VIII 1966 p 224–227 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The reversed-phase partition chromatography method was used to separate protactinium from thorium. The protactinium was found to be held on the column strongly, whereas thorium was easily eluted with HCl. The protactinium could then be eluted with 5% oxalic acid. Author

N67-16255# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

THERMOSTAT ACCURATE TO 5×10^{-4}°C [TERMOSTAT O DOKLADNOSCI TERMOSTATOWANIA 5×10^{-4}°C]

A. Selecki and J. Graczyk *In its* Nukleonika, Vol. VIII 1966 p 238–240 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The initial Shatenstein thermostat was modified for isotopic float analysis by adding temperature control, precise flow control by means of a calibrated needle valve, and preliminary thermostating of the cooling water circuit. These improvements decreased the amplitude of thermal oscillations from $(3-5)\times10^{-3}$ C to a value not exceeding $(3-5)\times10^{-4}$ C. G.G.

N67-16264# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

OH RADICAL INITIATED CHAIN OXIDATION OF IRON (II) IN AIR SATURATED ACID SOLUTIONS CONTAINING ALCOHOLS. II: REFINED ANALYSIS OF $G(Fe^{3+})$ IN THE PRESENCE OF C_2H_5OH AFTER THE PULSE ELECTRON IRRADIATION

L. Stolarczyk *In its* Nukleonika, Vol. VIII 1966 p 290–293 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

Refined analysis of the values of $G(Fe^{3+})$ after the termination of the chain processes induced by the pulse irradiation in air saturated aqueous solutions of 2.5×10^{-4}M Fe^{2+}, 0.4 M H_2SO_4 and 0 to 10^{-2} M C_2H_5OH was performed. The value of the ratio of rate constants of the reactions of OH radicals with Fe^{2+} ions and C_2H_5OH was evaluated as about 0.9 and that of the ratio of rate constants of the reactions of $CH_3CH(OOH)OH$ molecules with C_2H_5OH molecules and Fe^{2+} ions as about 0.0055. Author

N67-16265# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

THE SEPARATION OF ARSENIC FROM GERMANIUM BY REVERSED-PHASE PARTITION CHROMATOGRAPHY

I. Fidelis, R. Gwozdz, and S. Siekierski *In its* Nukleonika, Vol. VIII 1966 p 294–301 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

Reversed-phase partition chromatography has been applied for the separation of microamounts of arsenic from macroamounts of germanium. The availability of the method was proved for separation of carrier-free 77As from germanium target. The separation of two oxidation states of arsenic has been performed. Author

N67-16266# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

SEPARATION OF CARRIER-FREE ^{199}Au FROM PLATINUM BY REVERSED-PHASE PARTITION CHROMATOGRAPHY [VYDELENIE ZOLOTA Au^{199} BEZ NOSITELYA IZ PLATINOVOI MISHENI METHODOM RASPREDELITEL'NOI KHROMATOGRAFII S OBRASHCHENNYMI FAZAMI]

I. Fidelis, R. Gwóźdź, and S. Siekierski *In its* Nukleonika, Vol. VIII 1966 p 302–305 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The method of reversed-phase partition chromatography with TBP (Tributyl phosphate) as the immobile phase was the immobile phase was used to separate carrier-free gold from a platinum target. It was found possible to concentrate tracer solutions on a chromatographic column. Author

N67-16267# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Eenrgy.

THE DETERMINATION OF LEAD-210 AND BISMUTH-210 IN BIOLOGICAL MATERIAL

Z. Jaworowski *In its* Nukleonika, Vol. VIII 1966 p 306–313 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

A method for determination of lead-210 naturally present in biological material has been described. ^{210}Pb was first extracted to the chloroform together with stable lead as lead dithizonate and then ^{210}Bi daughter of ^{210}Pb is separated with cupferren. Beta activity of ^{210}Bi is then measured in low-background beta-counting units. Author

N67-16268# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

APPLICATION OF REVERSED PHASE PARTITION CHROMATOGRAPHY TO THE SEPARATION OF *n*-HEXYLIODIDE FROM IODOBENZENE AND *n*-PROPYLIODIDE

A. Sokolowska *In its* Nukleonika, Vol. VIII 1966 p 314–316 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

An efficient system for the separation of iododerivatives is described. Aqueous acetone or aqueous ethanol proved to be suitable mixtures for use as a stationary phase in the experiment, while aliphatic hydrocarbons were chosen for use as a mobile phase. Results are presented for a system using dodecane, the most suitable hydrocarbon, and a 75% aqueous acetone solution. A comparison of the separation factors determined by the stationary method for dodecane and calculated from the positions of maxima of the elution curves is also included. A.G.O.

N67-16273# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

OH RADICAL INITIATED CHAIN OXIDATION OF IRON (II) IN AIR SATURATED ACID SOLUTIONS CONTAINING ALCOHOLS. III: CHAIN PROCESSES IN GAMMA IRRADIATED SOLUTIONS CONTAINING C_2H_5OH

L. Stolarczyk *In its* Nukleonika, Vol. VIII 1966 p 363–366 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The $G(Fe^{3+})$ values were measured in air saturated aqueous solutions of 2.5×10^{-4} M Fe^{2+}, 0.4M H_2SO_4 and $0.5–10\times10^{-4}$ M C_2H_5OH after the gamma irradiation. An inflexion point on the curve of the relation between $G(Fe^{3+})$ and the concentration of C_2H_5OH was observed. The results are qualitatively explained as the competition between various chain mechanisms of iron oxidation and various possible chain breaking reactions. Author

N67-16274# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

STRIPPING OF URANIUM FOR TRI-n-OCTYLOAMINE EXTRACTS BY SODIUM CARBONATE SOLUTIONS [REEKSTRAKCJA URANU ROZTWORAMI WEGLANU SODOWEGO Z EKSTRAKTOW TROJ-n-OKTYLOAMINY]

M. Goliński and W. Korpak *In its* Nukleonika, Vol. VIII 1966 p 367–372 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

A study was conducted of the optimal conditions for stripping uranium from 0.1M TnOA (tri-n-octyloamine) plus 3 vol.% sec-n-octanol in kerosene. Polish uranium ores were leached with 5% sulfuric acid and extracted with TnOA. A 10% sodium carbonate solution was employed as the stripping agent. To achieve complete uranium stripping more sodium carbonate than required stechiometrically had to be supplied to the system. The phase separation depends on the mixing conditions, the extent of sodium carbonate concentration in the aqueous phase and the ferric ion concentration in the organic phase. Author

N67-16276# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

DETERMINATION OF MICROTRACE AMOUNTS OF MANGANESE IN NITRIC AND HYDROCHLORIC ACIDS BY NEUTRON ACTIVATION ANALYSIS [OZNACZANIE MIKROSLADOWYCH ZAWARTOSCI MANGANU W KWASACH AZOTOWYM I SOLNYM METODA AKTYWACJI NEUTRONOWEJ]

W. Otwinowski and Z. Allina *In its* Nukleonika, Vol. VIII 1966 p 383–391 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

A method is described for determining microtrace amounts of manganese in nitric and hydrochloric acids by neutron activation analysis. A total residue of evaporation of 10 cc of acid was irradiated in a nuclear reaction in a flux of 10^{13} slow neutrons per second per sq. cm. The radiochemical variant of this method was used and the beta-activity of ^{56}Mn was measured. The lower limit of determination was 5×10^{-11} g per cc. The coefficient of variation of the mean result (based on three independent determinations) was no greater than 30%. Author

N67-16277# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

THE FEASIBILITY OF THE FAST NEUTRON ACTIVATION ANALYSIS TO THE COPPER CONTENT DETERMINATION IN COPPER ORES

L. Gorski *In its* Nukleonika, Vol. VIII 1966 p 392–395 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

Proposed is an automatic analytical system for performing industrial routine determinations of copper contained in Low Silesia ore deposits. A detailed analysis of the activation of other ore components has demonstrated that only the following elements: Ca, Mn, Al, V, Mg, and Mo, could exhibit a considerable gamma activity when activated with slow neutrons. Among all ore components it was found that only the K, Zn, Mo, and Sb can be activated with fast neutrons to positron emitting isotopes. A detailed examination of the contents in the ore of these elements led to the conclusion that in the case of typical ores containing 2%Cu, 0.5%K, 0.25%Zn, 0.01%Ag, 0.005%Mo, and 0.001%Sb, the summarized positron activity of these elements will amount to only Ca 3% of the activity of copper. Studies of the feasibility of

the proposed analytical method demonstrated that the activity observed after having activated 5 g of the ore for two minutes in a flux of 10^7 fast n/cm^2 sec at about 2% copper concentration will give about 3×10^3 coincidences per minute. The mean time needed for determination is estimated to be about five minutes. S.C.W.

N67-16282# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

ON THE VARIOUS FORMS OF HYDROGEN ATOMS APPEARING IN THE GAMMA IRRADIATED AQUEOUS SOLUTIONS

W. Kolos *In its* Nukleonika, Vol. VIII 1966 p 420–431 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The ideas of the valence bond method have been applied to discuss the structure and stability of the hydrated electron and of the hydrated H_2 ion. Several resonance structures of the system have been considered and the energies of the structures estimated. It has been shown that in aqueous solutions the unstable H_2O^- ion may be stabilized by delocalization of the unpaired electron. For the resulting hydration complex the weight of the structure representing a hydrated H_2 ion increases with increasing acidity of the solution. Author

N67-16288# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

PRIMARY PROCESSES IN RADIATION CHEMISTRY AS STUDIED BY MASS SPECTROMETRY. III: DETERMINATION OF THE DISTRIBUTION OF PRIMARY DECOMPOSITION PRODUCTS OF TETRAHYDRONAPHTHALENE IN THE LIQUID PHASE

H. Wincel and Z. Kecki *In its* Nukleonika, Vol. VIII 1966 p 494–507 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

On the basis of the previously defined scheme of tetrahydronaphthalene molecule decomposition occurring under electron impact, and using the simplified theory of mass spectra, the distribution of unimolecular decomposition products of ionized excited tetrahydronaphthalene molecules in the liquid phase (time interval of decomposition–$1.92\times10^{13-}$ sec) was established. It was shown that with a decreasing of time scale of decomposition process from 10^{-6} to about 10^{-13} sec the relative abundances of the parent ions increase about five times on account of decreasing of the relative abundances of their decomposition products, i.e. positive and corresponding neutral species. Author

N67-16289# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

DETERMINATION OF IMPURITIES IN METALLIC BISMUTH BY NEUTRON ACTIVATION [DOSAGE DES IMPURETES DANS LE BISMUTH METALLIQUE PAR LA METHODE D'ACTIVATION NEUTRONIQUE]

L. Wodkiewicz *In its* Nukleonika, Vol. VIII 1966 p 508–515 refs In FRENCH; ENGLISH Summary (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The development of a neutron activation method to determine trace impurities in high purity materials is reported. A mathematical expression is given for the method analysis, and an analysis of bismuth samples as well as the application to dosage rates are described. The following elements were determined: Ag, As, Sb, Cu, Fe, Na, and Mn. The method's sensitivity, conditioned by the neutron flux, may reach 10^{-13} grams for some elements. The use of the multichannel gamma spectrometer is considered to provide rapid and precise analysis. The general accuracy of the method is ±10%. Transl. by R.Ll.

N67-16290# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

RAPID DETERMINATION OF LEAD IN POLYMETALLIC ORE SAMPLES BY ABSORPTION ANALYSIS [SZYBKIE OZNACZANIE KONCENTRACJI OLOWIU W PROBKACH RUD POLIMETALICZNYCH METODA ABSORPCYJNA]

B. Dziunikowski *In its* Nukleonika, Vol. VIII 1966 p 516–526 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

An absorption method is described for rapid determination of the lead content in ore samples with different concentrations of zinc and iron. Theoretical possibilities for avoiding the errors due to these elements are presented. An original solution based on the nomographic method is given for the problem. The experimental results and the accuracy of the method are discussed. Author

N67-16298# Polish Academy of Sciences, Warsaw. Committee for the Peaceful uses of Nuclear Energy.

SEPARATION OF TRACE AMOUNTS OF Pm, Eu, and Tb FROM MACROAMOUNTS OF ER [WYDZIELENIE BEZNOSNIKOWYCH ILOSCI Pm, Eu I Tb Z MAKROILOSCI Er]

B. Kotlinska-Filipek and S. Siekierski *In its* Nukleonika, Vol. VIII 1966 p 564–572 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The extraction coefficient was determined for macroamounts of erbium from HNO_3 into 1.5 M di-n-butyl-phosphate (DBP) in carbon tetrachloride. The concentration of HNO_3 was changed from 0.7 to 13 M and that of Er from 0.06 to 0.4 M. The extraction coefficient was also found for trace amounts of Tb in the presence of macroamounts of Er. Reversed-phase partition chromatography with DBP as the stationary phase and HNO_3 as the moving phase was used to separate tracer amounts of Pm, Eu, and Tb from as much as 500 mg of erbium nitrate. The column employed for this separation was 10 cm long and 1 cm in diameter. A method was developed for concentrating the effluent solution. The amount of erbium eluted from the column was shown to depend on the nitric acid concentraton. All of the erbium can be removed from the column by means of about 13 M HNO_3. Author

N67-16299# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

THE RADIATION INDUCED OXIDATION AND REDUCTION REACTIONS OF IRON IN AQUEOUS SOLUTIONS. V: THE DIRECT OBSERVATIONS OF REDOX PROCESSES IN THE IRRADIATED $Fe\text{-}H_2SO_4$-ISOBUTYL ALCOHOL-H_2O-O_2 SYSTEM. THE EFFECT OF THE CONCENTRATIONS OF Fe_2^+ AND Fe^{++} IONS AND OF ISOBUTYL ALCOHOL

R. Broszkiewicz *In its* Nukleonika, Vol. VIII 1966 p 573–581 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The effects of the concentrations of ferric and ferrous ions, isobutyl alcohol, and oxygen on the radiation induced oxidation and reduction reactions of the iron ions were observed during the irradiation. The measurements were taken in the solutions 0.1 N H_2SO_4. The results point out the importance of the concentration of ferrous ions in reactions terminating the chain as well as that of alcohol in reactions of the reduction of ferric ions. The steady state, observed at low concentrations of the ferrous ions, may be attributed to the presence of oxygen inhibiting the reduction. As a factor decisive on the whole process of oxidation and reduction turns out to be oxygen, which presence helps to start the oxidation of ferrous and absence enables the reduction of the ferric ions. Author

N67-16300# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

THE RADIATION INDUCED OXIDATION AND REDUCTION REACTIONS OF IRON IN AQUEOUS SOLUTIONS. VI: THE DIRECT OBSERVATION OF REDOX PROCESSES IN THE IRRADIATED $Fe\text{-}H_2SO_4$-ALCOHOLS-H_2O-O_2 SYSTEM. THE EFFECTS OF THE STRUCTURE OF ALCOHOL

R. Broszkiewicz *In its* Nukleonika, Vol. VIII 1966 p 582–589 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The processes of the oxidation of ferrous and reduction of ferric ions in the irradiated solutions consisting of $Fe(SO_4)_2$ H_2SO_4 and primary, secondary or tertiary alcohols have been investigated. The solutions were not deoxygenated. According to the spectrophotometric measurements taken directly during the irradiation it was observed that, at the concentrations applied, the processes of ferrous oxidation are relatively independent of the type of alcohol. The processes of the reduction of ferric ions proceed easier when the alcohol is more polar or is composed of a less number of H-atoms attached to the C-1 carbon, i.e. in the case of secondary or simple primary alcohols. The lack of H-atoms at the C-1 carbon considerably diminishes the reduction which happens in the case of tertiary alcohols. The decrease of polarity of a molecule of alcohol following the increase of the carbon chain, causes the decrease of G_{red} of ferric ions, which for the higher alcohols reaches the same value as for hydrocarbons.
Author

N67-16303# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

THE RADIATION INDUCED OXIDATION AND REDUCTION REACTIONS OF IRON IN AQUEOUS SOLUTIONS. VII: THE DIRECT OBSERVATION OF REDOX PROCESSES IN THE IRRADIATED $Fe-H_2SO_4$-CARBOXYLIC ACIDS-H_2O-O_2 SYSTEM. THE EFFECTS OF THE STRUCTURE OF ACIDS

R. Broszkiewicz *In its* Nukleonika, Vol. VIII 1966 p 595–601 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The effects of the structure of a carboxylic acid on the processes of oxidation and reduction of the iron ions in irradiated aqueous solutions have been directly observed during the irradiation. The solutions contained the mono- or dicarboxylic acid, H_2SO_4, $Fe(NH_4)_2(SO_4)_2$ and O_2. The ferrous oxidation was rather independent on the acid and its concentration, but the reduction of ferric was possible in the presence of formic, oxalic or valeric acid only. In the cases of formic and oxalic acid, as a reducing agent acts a COOH radical. The radical formed from the valeric acid acts similar to those formed from hydrocarbons. The G-values of oxidation and reduction of the iron ions have been established. The molar extinction coefficients for oxalic and malonic complexes of ferric ions have been determined.
Author

N67-16304# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

SOLVENT EXTRACTION OF CATIONS WITH ALKYL PHOSPHORIC ACIDS FROM SULFATE SOLUTIONS. III: THE EXTRACTION OF U^{VI} AND Fe^{III} IN THE PRESENCE OF CATIONS HAVING DIFFERENT ELECTRONIC CONFIGURATIONS THAN THAT OF INERT GASES [EKSTRAKTSIYA KATIONOV ALKILFOSFORNYMI KISLOTAMI IZ SUL' FATNYCH RASTVOROV. III: EKSTRAKTSIYA U^{VI} AND Fe^{III} V PRISUTSTVII KATIONOV NE IMEYUSHCHIKH ELEKTRONNOI KONFIGURATSII INERTNYKH GAZOV]

T. S. Urbanski *In its* Nukleonika, Vol. VIII 1966 p 602–608 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

A study has been made of how the sulfates of metals having electronic configurations different than that of inert gases—Co (II), Ni, Cu (II), Cd, and Mn (II)—affect the extraction of U (VI) and Fe (III) with DDPA or D^2 EHPA. The extraction coefficients of U (VI) and Fe (III) are presented as a function of pH in equilibrium. The orders are given of the accompanying cations with respect to the extraction coefficients for U (III) and Fe (III).
Author

N67-16305# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

A REFRACTOMETRIC STUDY OF THE INTERACTION BETWEEN DILUENTS AND MONODODECYLPHOSPHORIC ACID [BADANIA NAD WSPOLDZIALANIEM ROZCIENCZALNIKOW I KWASU MONODODECYLOFOSFOROWEGO METODA REFRAKTOMETRYCZNA]

L. Kohman *In its* Nukleonika, Vol. VIII 1966 p 609–618 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

A study has been made of a system used for uranium extraction monododecylphosphoric acid in a mixture of kerosene DDPA (k) and carbon tetrachloride (CCl_4)—as well as the binary systems, carbon tetrachloride and kerosene or m-ksylene, dodecyl alcohol, and n-butyl alcohol. The curves relating Δn_D^{20} to the composition by volume displayed extrema (D minima in the case of aromatic compounds and maxima in the case of other compounds), thus indicating interaction between the components. Changes in viscosity and density have also been investigated in relation to the composition and the infrared spectra of the DDPA(m)–CCl_4 system. These investigations confirmed the conclusions drawn from the refractometric study. It was found that the refractometric indices deviated increasingly from additivity as the length of hydrocarbon chain and its branches increased. The investigations confirm that the refractometric method is well suited for examining slight chemical interactions in a mixture which are difficult to observe by means of other physico-chemical methods.
Author

N67-16306# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

THE EFFECT OF ELECTRON DONORS ON THE ISOTOPIC EXCHANGE BETWEEN ALUMINIUM (III), GALLIUM (III) AND INDIUM (III) IODIDES AND ALKYL IODIDES

A. Polaczek and A. Halpern *In its* Nukleonika, Vol. VIII 1966 p 619–623 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The isotopic exchange of iodine between radioactive aluminum, gallium, and indium triiodides, and methyl, ethyl, and n-propyl iodides was studied. The exchange occurs rapidly in all the investigated systems. A significant blocking effect of electron donors on the reaction rate was observed.
Author

N67-16307# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

EFFECTS OF CARBON-14 BETA RAYS ON THE KINETICS OF THE ESTERIFICATION PROCESS [WPLYW PROMIENI β IZOTOPU C-14 NA KINETYKE PROCESU ESTRYFIKACJI]

A. Dorabialska, W. Swiatkowski, and S. Tilk *In its* Nukleonika, Vol. VIII 1966 p 624–630 refs (See N67-16221 06-06) CFSTI HC $3.00/MF $0.65

The kinetics of the ethanol esterification with acetic acid has been investigated by the conductometric method. In the first series of experiments normal acetic acid and in the second, acetic acid labled with carbon-14 in the carboxyl group, were used. The specific activity of the reacting solution was 0.01545 mc/ml. The initial concentrations of the reagents were the same (5 mole/liter) in all experiments. The temperature was maintained at 25.0±0.1°C and the measurements were carried out during 10 to 14 days. The conductivity vs. time kinetic curves obtained are of the second order in the case of normal acetic acid (the rate constant k was 8.9×10^{-5} 1% liter/h-mole). In the presence of carbon-14 during the first 170 hours of the reaction the conductivity change did not proceed according to the second-order rate law. The kinetic curves were steeper. The interpretation of the results is the beta rays caused about 2.37% of the acetic acid to be radiolyzed to nonionic products. It is believed that none of the products acts as a catalyst.
Author

N67-16314# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

REACTIONS OF CHLORINE WITH URANIUM RAW MATERIALS [REAKTSII KHLORA S URANOVYM SYR'EM]

J. Zienkiewicz *In its* Nukleonika, Vol. VIII 1966 p 673–692 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

Studies on the reaction of molecular chlorine with uranium raw materials in the presence of molecular carbon and carbon monoxide show that a general uranium extraction method can be based on that reaction. The product of the reaction consists of a mixture of volatile uranium derivatives accompanied by common and disseminated elements, use of which determines whether the process is economical. Author

N67-16315# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

THE EXTRACTION OF MINERAL ACIDS AND URANIUM SALTS BY ALIPHATIC SULPHOXIDES. II: THE EXTRACTION OF MINERAL ACIDS BY ALKYL SULPHOXIDES

W. Korpak *In its* Nukleonika, Vol. VIII 1966 p 693–700 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The extraction of mineral acids with some alkyl sulphoxides has been investigated. The formation of the $R_2SO{\times}HNO_3$, $R_2SO{\times}HClO_4$, $R_2SO{\times}HCl$ and possibly R_2SCl_2 has been found. The cryoscopic data obtained indicate that the alkyl sulphoxides used in benzene do not polymerize. The extent of extraction of the acids by the sulphoxides can be arranged as follows: $HNO_3 > HClO_4 > HCl$. The differences in the extraction of these acids may be explained by their various behavior in concentrated solutions. It is therefore expected that similar differences should be observed during the extraction of uranyl chloride and nitrate with the sulphoxides. The possibility of indirect determination of the sulphoxides in organic diluents has been indicated. Author

N67-16318# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

AN IMPROVED METHOD FOR DETERMINATION OF CESIUM-137 IN RAINWATER

J. Derecki, J. Geisler, and Z. Jaworowski *In its* Nukleonika, Vol. VIII 1966 p 728–730 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

In the recently published detailed procedure for determination of cesium-137 in water and urine, the detection limit was found to be 22 and 51 picocuries respectively. This method bases on ion exchange of cesium-137 on ammonium molybdophosphate (AMP) mats was found to be especially convenient for routine measurements of personal contaminations. The presently published modification of this method enables detection of cesium-137 in water in amounts of approximately one picocurie. It consists of changing the size of AMP mats and not using asbestos. This enables the measurements of the samples to be carried out in low-background beta counting unit. Author

N67-16320# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

REACTIONS OF CHLORINE WITH URANIUM OXIDES [REAKTSII KHLORA S OKISLAMI URANA]

J. Zienkiewicz *In its* Nukleonika, Vol. VIII 1966 p 745–767 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

Studies on the system (UO_xCl_2) show that UO_2 reacts at 225°C while U_3O_8 and UO_3 do not react until 900°C. When carbon is introduced into the system the starting temperature of the reaction is reduced to below 300°C. The composition of the products depends on the reaction zone temperature as the temperature rises the oxygen content drops from 2 to 0, the chlorine content increases from 2, reaches a maximum of 5, and then drops to 4. The efficiency decreases when carbon monoxide instead of carbon is introduced. Author

N67-16321# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

TRACER STUDIES ON THE EXTRACTION OF METAL IONS. VI: EXTRACTION OF SCHIFF BASE METAL CHELATES OF URANIUM, IRON, COPPER, NICKEL, AND SEPARATION OF URANIUM FROM RARE-EARTH ELEMENTS

J. Mikulski and I. Stronski *In its* Nukleonika, Vol. VIII 1966 p 768–772 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The relation between the hydrogen ion concentration of the water phase and the yield of extraction (%E) of UO^{2+}, Fe^{3+}, Ni^{2+} and Cu^{2+} ions by means of bis-salicylaldehyde-ethylen-diamine, in the system water-chloroform, was studied radiometrically. The uranyl ions were separated from the tervalent praseodymium and gadolinium ions. Author

N67-16322# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

DETERMINATION OF TRACE AMOUNTS OF COPPER, ZINC, ARSENIC AND IRON IN HIGH-PURITY SELENIUM BY NEUTRON ACTIVATION ANALYSIS [OZNACZANIE SLADOWYCH ZAWARTOSCI MIEDZI, CYNKU, ARSENU I ZELAZA W CZYSTYM SELENIE METODA AKTYWACJI NEUTRONOWEJ]

W. Otwinowski and Z. Allina *In its* Nukleonika, Vol. VIII 1966 p 773–782 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

Methods are described for determining trace amounts of copper, zinc, arsenic and iron in high-purity selenium by neutron activation analysis. Samples of selenium and appropriate standards were irradiated in a nuclear reactor for 20–22 hours at a flux of 10^{12} thermal neutrons per second per sq cm. Radiochemical purification of the elements to be determined was used and the beta-activity of 64Cu, 69mZn, 76As, and 59Fe was measured. The lower limit of determination was 10^{-8} g Cu/g, 10^{-6} g Zn/g, $5{\times}10^{-9}$ g As/g and $5{\times}10^{-5}$ g Fe/g. The coefficient of variation of the main result (based on 3 independent determinations) was no more than 15%. Author

N67-16333# Pratt and Whitney Aircraft, East Hartford, Conn.

INVESTIGATION OF MECHANISMS FOR ELECTROCHEMICAL CATALYSIS Quarterly Report, May 1–Jul. 31, 1966

J. R. Aylward and S. W. Smith Ft. Monmouth, N. J., Army Electron. Command, Nov. 1966 32 p ref
(Contract DA-28-043-AMC-02205(E))
(ECOM-02205-1; PWA-2911; AD-641412) CFSTI: HC $3.00/MF $0.65

A program is being conducted to investigate the mechanisms of electrocatalysis with respect to the anodic oxidation of selected fuels by novel electrocatalysts in acid electrolyte at temperatures below 150C and at ambient pressure. The transition-metal silicides were chosen for study on the basis of previous work which indicated some catalytic activity for these materials for fuel oxidation. The electrochemical properties of the silicides in acid electrolyte were investigated by measuring the polarization behavior using both potential sweep and steady-state methods. Tests were performed in inert-gas saturated electrolyte to determine corrosion resistance and characteristics of oxide film formation, and then in hydrogen-saturated electrolyte or in electrolyte which is 0.1 molar in methanol to evaluate the catalytic activity. The results showed that the corrosion current for these materials in acid electrolyte is low, generally about 0.00001 amp/sq cm. The oxide films formed on the silicides are good electronic conductors and form through a reversible process. The silicides by themselves were found to have no significant activity for the electrochemical oxidation of hydrogen or methanol, but, when combined with trace amounts of platinum, they demonstrated considerable activity. Author (TAB)

N67-16352# Naval Ordnance Lab., White Oak, Md. Non-Metallic Materials Div.
THERMODYNAMIC PROPERTIES OF POLYBUTENE-1 AND BUTENE-1
R. W. Warfield and M. C. Petree 20 Sep. 1966 25 p refs
(NOLTR-66-171; AD-641867) CFSTI: HC $3.00/MF $0.65

Using published specific heat data, the entropy, enthalpy, and Gibbs free energy of polybutene-1 (PB) were calculated over the temperature range 0 to 315K. The encraty, C sub p/T vs. T, calculated for PB exhibits a maximum at 60K and a small inflection at about 250K, which is associated with the glass transition. The difference, C sub p-C sub v, was calculated at 298.15K and found to be 0.047 cal/gm deg. The thermodynamic functions were also calculated for butene-1. At 265K the entropy of polymerization is 32.57 cal/mole deg, and the free energy of polymerization was found to be -12.1 kcal/mole. Author (TAB)

N67-16355# California Univ., Los Angeles. Dept. of Chemistry.
MODELS FOR ASYMMETRIC INDUCTION IN POLYMERIZATION Final Report, 1 Oct. 1964–30 Sep. 1966
Donald J. Cram 15 Oct. 1966 5 p refs
(Grant AF-AFOSR-124-65)
(AFOSR-66-2571; AD-641797) CFSTI: HC $3.00/MF $0.65

Both synthetic and natural synthetic polymers, for example stereo-regular polypropylene and cellulose, contain many asymmetric centers whose configurational relationships are fixed rather than random. The work summarized in this paper, models for 1,3- and 1,5-asymmetric induction were developed. These models, based on simple reactions, demonstrate the general validity of a rational steric approach to the mechanism of ordered elaboration of asymmetric centers in synthetic and natural polymers. Author (TAB)

N67-16356# Washington Univ., Seattle. Dept. of Chemistry.
REACTIONS OF PENTAFLUOROSULFUR HYPOFLUORITE WITH Cl_2, Br_2, I_2, NO, NO_2, AND PF_3
B. W. Tattershall and George H. Cady 14 Oct. 1966 10 p refs
(Contract Nonr-477(16); ARPA Order no. 26-60)
(TR-58; AD-641219) CFSTI: HC $3.00/MF $0.65

Bis(fluoroxy) difluoromethane, CF2(OF)2, was produced by the reaction of fluorine with carbon dioxide in the presence of cesium fluoride at room temperature. Author (TAB)

N67-16357# Naval Air Engineering Center, Philadelphia, Pa.
ANALYSIS OF METALLIC MATTE, ORIGIN UNKNOWN
F. S. Williams 26 Sep. 1966 5 p
(NAEC-AML-2488; AD-640545) CFSTI: HC $3.00/MF $0.65

A sample of material was examined for identification and possible clues regarding its origin. Based on spectrographic analysis, electron diffraction studies, and comparison of the specific gravity with that of materials reported in the literature, it is considered that the sample probably orginated from a refining or smelting process for cobalt and nickel. Author

N67-16393# Mound Lab., Miamisburg, Ohio.
NEUTRON MULTIPLICATION DETERMINATION OF PLUTONIUM-238 DIOXIDE
R. A. Wolfe and J. B. Kahle 5 Oct. 1966 21 p ref
(Contract AT(33-1)-GEN-53)
(MLM-1340) CFSTI: HC $3.00/MF $0.65

A neutron multiplication experiment was performed with 21 storage capsules containing high isotopic analysis plutonium dioxide. Each storage capsule contained approximately 80 grams of the ^{238}Pu isotope. The capsules were assembled in a heterogeneous array spaced four inches center-to-center and measurements were made independently in a water and in an air medium. The results indicated that no neutron multiplication was detectable in the fully assembled array in a water medium. However, a slight neutron multiplication of 1.29 existed in the fully assembled array in an air medium. Author (TAB)

N67-16401# Picatinny Arsenal, Dover, N. J. Plastics and Packaging Lab.
EXPLORATION OF THE FEASIBILITY OF PREPARING DOUBLE CHAIN NOVOLAC RESINS
E. A. Hoess and W. C. Tanner Oct. 1966 30 p refs
(PA-TR-3346; AD-641872) CFSTI: HC $3.00/MF $0.65

Soluble novolac resins were prepared by means of a snythetic scheme devised to yield double chain novolac resins from polyhydric polynuclear phenols. The bisphenols were the only polyhydric phenols which gave soluble polymers. Further work will be needed to determine whether the polymers obtained are ordered networks or soluble micro gels. Author (TAB)

N67-16431# Maryland Univ., College Park. Dept. of Chemistry.
VELOCITY AND ABSORPTION OF SOUND IN EQUILIBRIUM CHEMICAL SYSTEMS Final Report, 16 Sep. 1961–30 Sep. 1966
Gordon Atkinson Sep. 1966 9 p refs
(Contracts DA-ARO(D)-31-124-G175; DA-ARO(D)-31-124-G502)
(AROD-3417-5; AD-642615) CFSTI: HC $3.00/MF $0.65

A study of ion association in electrolyte solutions by use of ultrasonic absorption measurements is summarized. The research was conducted to explore in as many systems as possible and with as much precision as possible, the idea of step-wise ion association proposed originally by Manfred Eigen. Author (TAB)

N67-16447# Minnesota Univ., Minneapolis. Dept. of Chemistry.
POLYNUCLEAR HYDROXO COMPLEXES Final Technical Report, 1 Oct. 1964–30 Sep. 1966
R. Stuart Tobias 30 Sep. 1966 12 p refs
(Grant AF-AFOSR-691-65)
(AFOSR-66-2739; AD-643021) CFSTI: HC $3.00/MF $0.65

A continuous flow system was built for studies on moderately fast reactions. Initially it was used in studies of the acid strength of (CO(NH3)5OD2) (+3) compared with (CO(ND3)5OD2) (+3) and (CO(NH3)5OH2) (+−3). A normal isotope effect is observed, contrary to what has been reported in the literature. The flow system was then used in some preliminary studies of the condensation of the conjugate base (CH3)2SNOH(+) to yield a dimer. This condensation proved to be too rapid to study. Studies were initiated on organo platinum (IV) and gold (III) species in order to obtain less labile model compounds. Dimethylgold (III) hydroxide was identified as a tetramer both in the crystalline state and in non-coordinating solvents. Carbanion ligands were observed to exert a pronounced labilizing effect on the other ligands in the first coordination sphere of metal ions. Rates of water exchange were estimated for several aquo ions using oxygen-17 NMR. Author (TAB)

N67-16450# Stauffer Chemical Co., Adrian, Mich. Silicone Div.
RESEARCH ON SYNTHESIS AND CHARACTERIZATION OF HIGHLY ARYLATED ORGANOSILICON COMPOUNDS Final Report
G. M. Hart, B. D. Karstedt, C. W. Newing, K. C. Pande, K. S. Shim et al Wright-Patterson AFB, Ohio, ARL, Jul. 1966 62 p refs
(Contract AF 33(616)-8355)
(ARL-66-0139; AD-641414) CFSTI: HC $3.00/MF $0.65

A series of fifteen organosilicon monomers was prepared via the reaction of organolithium reagents and Grignard reagents with tetrahalosilanes and organohalosilanes. In general, the compounds are aryl or bromoaryl monosubstituted derivatives of various diorganodihalosilane and triorganohalosilane intermediates. A

significant exception to this generalization is the series of compounds containing the 2,2-biphenylenesilyl moiety which was prepared via a cyclization reaction between 2,2-dilithiobiphenyl and an appropriate polyhalosilane. Steric hindrance, a difficulty encountered in synthesizing several of the desired intermediates, was circumvented by the use of the reaction between Grignard reagents and fluorosilanes. Author (TAB)

N67-16459# Library of Congress, Washington, D. C. Aerospace Technology Div.
TEMPERATURE STUDIES OF THE ELECTRICAL CONDUCTIVITY AND PHOTOCONDUCTIVITY OF MONOHALO DERIVATIVES OF BENZENE Translations of Foreign Scientific and Technical Literature
R. G. Romanets 26 Sep. 1966 8 p refs Transl. into ENGLISH from Zh. Prik. Spektroskopii (Moscow), v. 4, no. 5, 1966, p 410–414
(ATD-66-118; TT-67-60038; AD-642414) CFSTI: HC $3.00/MF $0.65

An investigation of the temperature dependence of dark conductivity and of photoconductivity of monohalo derivatives of benzene (iodobenzene, bromobenzene, and chlorobenzene) in the temperature range 330-200K, which covers the liquid and solid phase, established that these quantities vary with temperature according to an exponential law. The activation energies for dark conductivity and photoconductivity of the investigated substances were approximately twice as high in the solid phase as in the liquid phase. Author (TAB)

N67-16471# Marine Engineering Lab., Annapolis, Md.
THE OXYGEN–PEROXIDE COUPLE ON PLATINUM
R. J. Bowen and H. B. Urbach Dec. 1966 16 p refs
(MEL-TM-447/66; AD-643400) CFSTI: HC $3.00/MF $0.65

As a part of an investigation of fuel cell materials at deep sea ambient conditions, the oxygen–peroxide couple was studied on bright platinum. The circuit potential of platinum electrodes in alkaline open electrolyte obeys the Nernst equation for the oxygen–peroxide couple at low concentrations of peroxide. The experimental potential 0.762 volt rhe is in close agreement with the theoretical value of 0.752 volt. At high concentrations of peroxide a mixed potential is formed which is nearly independent of the peroxide concentration but dependent upon the oxygen concentration. Author (TAB)

N67-16474# Pennsylvania Univ., Philadelphia. Electrochemistry Lab.
ELECTRO-OXIDATION OF SATURATED HYDROCARBONS ON PLATINIZED PLATINUM IN PHOSPHORIC ACID
Glenn Stoner and John O'M. Bockris Oct. 1966 19 p refs
(Contract DA-44-009-AMC-469(T))
(Rept.-4; AD-643386) CFSTI: HC $3.00/MF $0.65

The anodic oxidation of normal hexane and cyclohexane in phosphoric acids gives two sets of measured parameters in two defined potential regions. Both sets are consistent with the same rate-determining step if one postulates a change from Langmuir to Temkin adsorption kinetics going from the lower (0.3–0.5 V) to the upper (0.57–0.8 V) potential region. The electrochemical activities of the hydrocarbons vary as follows: i sub C2H6 nearly equal to i sub C3H8 = 5 i sub n-hexane = 10 i sub cyclohexane. Author (TAB)

N67-16482# Universiy of South Florida, Tampa.
A STUDY OF ORGANOMETALLIC-CHELATE COMPOUNDS Final Report, 1 Sep. 1964–30 Jun. 1966
Dean F. Martin 30 Jun. 1966 11 p refs
(Grant DA-ARO(D)-31-124-G588)
(AROD-5200-6; AD-641605) CFSTI: HC $3.00/MF $0.65

A summary is given of work involving the coordination chemistry of chelate compounds which have had organometallic ions substituted for the central metal ion. Topics include: equilibria of complex formation; studies of reaction mechanisms; studies of stereochemistry and chemical bonding. TAB

N67-16491# Naval Ordnance Lab., White Oak, Md.
THE SYNTHESIS AND CHARACTERIZATION OF SPIRO POLYMERS
Angelo A. Volpe and William J. Bailey 9 Sep. 1966 35 p refs
(NOLTR-66-120; AD-641873) CFSTI: HC $3.00/MF $0.65

The synthesis of the first completely organic spiro polymers is reported. This was accomplished by the acid-catalyzed condensation of pentaerythritol with 1,4-cyclohexanedione and with 1,10-cyclooctadecanedione. The temperature at which 50% decomposition occurs of these polymers was determined by thermogravimetric analysis and was found to be in the 400–450°C range, which was higher than expected for nonaromatic, oxygen-containing polymers. The proof of structure of these spiro polymers, in which they were shown to be linear polyspiroketals rather than randomly cross-linked polymers, was accomplished by infrared analysis, elemental analysis, X-ray crystallography, intrinsic viscosity measurements, and solubility studies. Several other spiro polymers of lower molecular weight were synthesized and a correlation between molecular weight and thermal stability, as well as solubility, was observed. Finally, a copolymer of pentaerythritol, 1,4-cyclohexanedione and 1,10-cyclooctadecanedione was synthesized and its thermal properties, solubility characteristics, and molecular structure were studied. Author (TAB)

N67-16493# Monsanto Research Corp., Everett, Mass. Boston Lab.
CHEMILUMINESCENT SYSTEMS Final Technical Report, 1 Jun. 1964–31 May 1966
John S. Driscoll et al 30 Nov. 1966 161 p refs
(Contract Nonr-4511(00); ARPA Order 299)
(MRB3009F; AD-643132) CFSTI: HC $3.00/MF $0.65

The objective of this research program was the discovery of bright chemiluminescent reactions suitable for development into illumination and marking devices for field use. Over 175 organic compounds were investigated in the DMSO/T-BUOK/02 system in a general screening program. It is concluded from the data that chemiluminescence is a very general phenomenon. Almost every compound studied gave at least weak emission. The indoles were the most promising class of compounds studied. An investigation of 56 indole derivative showed numerous explainable substituent effects. Skatole (3-methylindole) fulfills these conditions and was found to be the brightest system studied. The chemiluminescent emitter in the skatole system was unambiguously identified as the excited singlet state of the anion of orthoformamidoacetophenone (FAP). The agreement between the chemiluminescence spectrum of the skatole system, and the fluorescence emission spectrum of FAP is among the best to be found for any known system. The emitter in the 2,3-dimethylindole system was shown to have a structure analogous to FAP. Author (TAB)

N67-16498# Frankford Arsenal, Philadelphia, Pa.
FLUORINATED NITROGEN HETEROCYCLES VIA CYCLIZATION. II: 3-TRIFLUOROMETHYLGLUTARIMIDES FROM FLUORINATED $\alpha\beta$-UNSATURATED CARBONYLS AND CYANOACETAMIDE
Seymour Portnoy 1966 6 p refs
(FA-A66-12; AD-642293)

Fluorinated alpha, beta-unsaturated carbonyls, having the general structure CF3(R)-C = CHCOOEt, undergo cyclization with cyanoacetamide via Michael addition and ring closure to give new trifluoromethyl gluterimides. In contrast to beta-trifluoromethyl substituted intermediates, no cyclization occurred utilizing methyl

alpha-trifluoromethyl acrylate under similar reaction conditions. Spectral evidence is presented which indicates that conversion of these compounds to the salt probably involves the enolization of the carbonyl adjacent to the nitrile substituent. Author (TAB)

N67-16499# Miami Univ., Fla. Dept. of Pediatrics.
STUDIES IN THE CYCLOBUTANE SERIES Final Report, 2 Oct. 1963–1 Sep. 1966
Irving Lillien 1 Sep. 1966 13 p refs
(Grant AF-AFOSR-123-63)
(AFOSR-66-2002; AD-640715) CFSTI: HC $3.00/MF $0.65

The primary accomplishments included the synthesis and study of derivatives of the 3-isopropylcyclobutane system, which provided successful ingress to means for defining conformational consequences of nonplanarity. Cis and trans 3-isopropylcyclobutanecarboxylate esters were equilibrated: cis and trans 3-isopropylcyclobutylamines and cis and trans 3-isopropylcyclobutanols were synthesized and configurational assignments made by reference to equilibrated ester. NMR spectra of the above series of compounds, and the equilibration data, strongly support the conclusion that the isopropyl group is effective as a holding group in this system, the alcohols and amines appear to be conformationally homogeneous. Deamination of the cis and trans amines produce a mixture of the same five products but in significantly different ratios. Thus, there is little or no likelihood of a common intermediate, classical or non-classical, and results are interpreted in terms of concertion involving the conformational distinction between equatorial and axial amino groups. Author (TAB)

N67-16527# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
QUANTITATIVE ELECTRODEPOSITION OF ACTINIDES FROM ISOPROPYL ALCOHOL
M. Yates Donnan and E. Kenneth Dukes Aug. 1966 10 p refs
(Contract AT(07-2)-1)
(DP-1048) CFSTI: HC $3.00/MF $0.65

An electrodeposition method was developed for the preparation of thin, uniform alpha sources for precise counting and accurate pulse height analysis. The method employs an isopropanol electroplating medium and is applicable to deposition of actinides for both organic and aqueous media. Moderate amounts of aluminum and iron do not decrease deposition yields. Author (NSA)

N67-16528# Mound Lab., Miamisburg, Ohio.
MOUND LABORATORY PROGRESS REPORT FOR JULY 1966
J. F. Eichelberger, G. R. Grove, and L. V. Jones 11 Feb. 1966 26 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1274) CFSTI: HC $3.00/MF $0.65

The swing system in the lower (^{13}C product) stages of the methane thermal diffusion cascade was removed and interstage circulation pumps were installed. The pumps for the lowermost stages were miniature canned pumps of a new design. The low-temperature fractional distillation column for enriching CO in ^{13}C was delivered and installed. In pilot experiments with material of 4.5% ^{13}C enrichment, high-purity elemental C was produced from CO_2. Experimental work to determine the effect of varying the amine solution flow rate on ^{13}C separation factor was continued. After lowering the ^{38}Ar peak into the third stage, over one liter of 17.8% ^{38}Ar was withdrawn. The third pass for enriching ^{86}Kr was started. Over 70% ^{86}Kr is being accumulated. A second run on a six-stage cascaded system with a modified gas circulating system enriched ^{131}Xe to 18%. Cascade calculations were made for separation of ^{124}Xe from natural Xe (natural abundance = 0.096%) in the 24-column tube bundle system. The heats of adsorption of Kr and Xe on Linde's Molecular Sieve 5A, 50/60 mesh were calculated to be −3091 cal/mole and −5127 cal/mole, respectively, based on separations made using He carrier gas. A complete set of experimental thermal diffusion column transport coefficients was obtained for ^{20}Ne and ^{22}Ne in one of the 12-foot experimental columns. The theoretical expressions for the transport properties of gases are used as relations between measurable quantities. Values of the diffusion coefficient and thermal diffusion factor for ^{3}He and ^{4}He mixtures were calculated and the thermal conductivity of ^{3}He was calculated from its viscosity. A computer program was written to calculate collision integrals for an arbitrary intermolecular potential function. Collision integrals for the modified Buckingham ($\alpha = 14$) potential were calculated. A flip coil for measuring small magnetic fields was built to measure the residual field of superconducting solenoids. The metal constituents in metal–organo compounds were determined by neutron activation analysis. NSA

N67-16531# Isochem, Inc., Richland, Wash.
CONTINUOUS URANIUM PEROXIDE PRECIPITATION
M. H. Curtis Apr. 1966 20 p refs
(Contract AT(45-1)-1851)
(ISO-207) CFSTI: HC $3.00/MF $0.65

A continuous process for peroxide precipitation of uranium from nitrate solutions is described. The basis for the process is the use of acetic acid complexing and ammonium hydroxide pH adjustment prior to the peroxide precipitation. Use of this method results in low filtrate waste losses (<0.01 g of U per liter), and a slurry with excellent filtration rates. Continuous precipitation is made by blending a dilute (5%) hydrogen peroxide stream with the precipitation feed stream. Ambient temperature, vigorous agitation, and a 10 to 20 min residence time are required. NSA

N67-16535# Oak Ridge National Lab., Tenn.
ION-EXCHANGE SEPARATION OF CURIE QUANTITIES OF YTTRIUM-90 FROM STRONTIUM-90 WITH DTPA AND HEDTA
P. B. Orr May 1966 20 p refs
(Contract W-7405-ENG-26)
(ORNL-3903) CFSTI: HC $3.00/MF $0.65

Twelve ion-exchange systems were investigated that used varied pH values and concentrations of diethylenetriamine–pentaacetic acid (DTPA) and N-hydroxyethylethylenediamine triacetic acid (HEDTA) to separate curie quantities of ^{90}Y from ^{90}Sr. Several systems gave high-purity ^{90}Y, and in all systems the chelating agents were destroyed by fuming with HNO_3. A 2% HEDTA system at pH 5 gave a separation factor $> 10^8$ and, by suitable operations on the eluted fractions, 70 to 80% of the ^{90}Y content of the starting material was recovered in 5 to 6 hours. Author (NSA)

N67-16616*# Oklahoma City Univ., Okla.
RAPID TECHNIQUE FOR LIQUID SCINTILLATION COUNTING OF CARBON-14-LABELLED CARBONATE BARIUM
John B. Allred [1966] 6 p refs
(Grants NsG-300; PHS-G-AM-06673)
(NASA-CR-81342) CFSTI: HC $3.00/MF $0.65 CSCL 07D

The method utilizes sonication to rapidly reduce particle size, thus decreasing preparation time and settling rate, and eliminating the need to agitate the sample between successive counts or correct for the settling rate. The procedure consists of weighing $BaC^{14}O_3$ into glass counting vials, in amounts from 10 to 40 mg and then adding 10 ml of counting soluton. Each sample is subjected to sonication for 20 to 30 seconds using a sonifier tuned to maximum overtones. The probe of the sonifier is then rinsed with an additional 5 ml of counting solution. After cooling to 2°C, each vial is vigorously agitated just prior to counting. Each sample is counted for 3 minutes three successive times without agitation between counts using a liquid scintillation counter. In studies on settling rates, counts are recorded for each 3 minute

interval for a period up to 30 minutes, with no agitation between counts. It is reported that the most important aspect of this modification of previous methods is the reduced time needed for sample preparation. C.T.C.

N67-16631*# Pennsylvania State Univ., University Park. Materials Research Lab.
RESEARCH ON THE MECHANISM AND KINETICS OF OXIDATION SILICON IN AIR Semiannual Report, 1 Jun.–30 Nov. 1966
K. Vedam, F. Lukes, and R. Rai 27 Dec. 1966 37 p refs
(Grant NGR-39-009-042)
(NASA-CR-81334; SAR-3) CFSTI: HC $3.00/MF $0.65 CSCL 07D

Reported are ellipsometric studies on the growth of thin oxide film on silicon in air. After calibration of the components of the ellipsometer, the thicknesses of the oxide films grown in air were measured by two different methods on polished silicon and germanium, on etched silicon, and on freshly cleaved silicon samples. These studies indicate that the Elovich equation can be used to describe the rate of oxidation in the later stages. Preliminary measurements on the thickness of the oxide layer on silicon by allowing the light to be incident on the film from a liquid confirm that the sensitivity attained by this technique is much higher than previously reported. However, the technique suffers from some experimental difficulties. Theoretical computations indicate that for angles of incidence ϕ_0 greater than the critical angle ϕ_c, the sensitivity is not as high as when ϕ_0 is slightly less than ϕ_c. Progress in the instrumentation of the ellipsometer in particular for the rapid determination of the readings, is also reported. K.W.

N67-16641# Thiokol Chemical Corp., Denville, N. J. Reaction Motors Div.
CARBORANE–SILOXANE ELASTOMERS Quarterly Report, 19 Aug.–18 Dec. 1966
Nathan Mayes and Alan Jackson 18 Dec. 1966 22 p refs
(Contract DA-11-070-AMC-852(W))
(RMD-5065-Q7; QR-7; AD-643356) CFSTI: HC $3.00/MF $0.65

The synthesis of polymer of structure Si(CH3)2B10H10C(CF2)5CB10H10CSi(CH3)2O- was outlined, and work toward the preparation of precursors was initiated. A new method for the preparation of m-carborane was investigated and developed, and the reactions leading to products that may have the desired structure, HCB10CC(=O)(CF2)3C(=O)B10H10CH, were conducted. Author (TAB)

N67-16649# California Univ., Los Angeles. Dept. of Chemistry.
IONIC FORCES IN POLYMERS—SOME PROPERTIES OF THE POLYPHOSPHATES IN THE GLASS TRANSITION REGION
Adi Eisenberg Aug. 1966 103 p refs *Its* Contrib. No. 1976 Submitted for Publication
(Contract Nonr-233(87))
(TR-13; AD-643403) CFSTI: HC $3.00/MF $0.65

The effect of ionic forces on the properties of polymers is reviewed with particular reference to the polyphosphates in the glass transition region. First, the work on the glass transition is discussed, specifically with regard to its dependence on the molecular weight, the nature of the chain end, and the nature of the counterion, and the applicability of various theories is demonstrated. Next, viscoelasticity of ionic polymers is reviewed, with particular emphasis on the distribution of relaxation times, ion-catalyzed bond interchange reactions of polymers are presented, with particular reference to the separation of multiple mechanisms occurring simultaneously with comparable relaxation times, as well as the mechanistic and kinetic details of the interchange process. The action of cations as crosslinks in anionic polymers is also reviewed. Author (TAB)

N67-16652# Pennsalt Chemicals Corp., King of Prussia, Pa.
HIGH PRESSURE (70 KBAR) SYNTHESIS OF NEW CRYSTALLINE LEAD DICHALCOGENIDES
Meyer S. Silverman Oct. 1966 10 p refs Submitted for Publication
(Contract Nonr-2687(00))
(TR-51; AD-640762) CFSTI: HC $3.00/MF $0.65

By subjecting mixtures of the elements or of lead monochalcogenides with excess sulfur and selenium to temperatures of 600C to 2400C and pressures of 20 to 70 kilobars, it was possible to synthesize the stable crystalline compositions PbSe2, PbSSe and two polymorphs of PbS2, one of the latter appearing to be isomorphous with SnS2. TAB

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N67-15344# Ohio State Univ. Research Foundation, Columbus.
ELECTRONIC POLARIZATION CONTROL Final Engineering Report, 7 Feb. 1964–31 Mar. 1966
31 Mar. 1966 17 p refs
(Contract NOw-64-0293-D)
(Rept.-1804-7; AD-640934) CFSTI: HC $3.00/MF $0.65

The accomplishments of a research program on polarization aspects of microwave antennas are summarized. Two basic areas were investigated; i.e., electronic polarization control techniques and the effect of polarization control on radome boresight error. Analyses were developed for determining boresight error with two-dimensional radome geometries; and methods of optimum radome design were determined. Two polarization control devices and an electronic phase shifter for use with these devices were tested. Author (TAB)

N67-15351# Naval Ordnance Lab., Corona, Calif.
TWO-WAY ANTENNA PATTERN SIMULATION BY ANALOG AND ANALYTICAL METHODS
J. B. Preston and G. L. Ruptier 20 Oct. 1966 38 p refs
(NOLC-683; AD-642614) CFSTI: HC $3.00/MF $0.65

Two methods of measuring two-way antenna patterns are discussed, both of which use portions of existing antenna pattern recording equipment as an electromechanical computer to simulate a two-way pattern. One of these, the Log Sum method, is tested on a two-way antenna system composed of four flush-mounted slots equally spaced around the circumference of a cylinder with a diameter of 11 wavelengths. A theoretical pattern is calculated by assuming that two of the slots transmit in-phase signals and the other two receive a return signal from an isotropic scatterer in the far field. This theoretical pattern is compared with an experimental pattern obtained at the NOLC antenna range. The good agreement of the patterns indicates that the Log-Sum method is valid and useful. Author (TAB)

N67-15352# Mitre Corp., Bedford, Mass.
THE APPLICATION OF HF CHANNEL DATA TO THE DEVELOPMENT OF BLOCK ERROR CORRECTORS
Kenneth Brayer and Otto Cardinale Bedford, Mass., AFSC, Electron. Systems Div., Sep. 1966 57 p refs
(Contract AF 19(628)-5165)
(MTP-32; ESD-TR-66-317; AD-642352) CFSTI: HC $3.00/MF $0.65

Error patterns of high-speed digital data transmission over an operational long-haul HF data link have been obtained for extensive time periods and used to develop statistical description. Distribution functions have been calculated for the cases of consecutive errors, error-free intervals, and bursts and their associated intervals, and processed to obtain maximum error correction with minimum-size interleaving. Author (TAB)

N67-15382# Ballistic Research Labs., Aberdeen Proving Ground, Md.

VHF AND UHF HIGH-G TELEMETRY INSTRUMENTATION FOR HARP VEHICLES

W. H. Mermagen, W. J. Cruickshank, and F. Vrataric (Harry Diamond Labs.) *In* AGARD The Fluid Dyn. Aspects of Ballistics 1966 p 439–464 refs (See N67-15361 06-12) CFSTI: HC $3.00/MF $0.65

Telemetry systems capable of surviving gun-launched accelerations in the order of 60,000 g have been developed for the High Altitude Research Program. Such telemetry systems have been used to provide data on the flight dynamics of gun-launched vehicles as well as measurements of upper atmospheric phenomena. The results of measurements of electron densities and temperatures in the upper atmosphere are presented and discussed. Vehicle roll rates and pitch-yaw frequencies have been measured during high altitude flights. The results are presented and some anomalous examples are discussed. It has been shown that the technique of using guns to launch instrumented payloads into the upper atmosphere is both practical and useful. Moreover, the inclusion of on-board instruments to observe the dynamical behavior of flight vehicles provides a useful tool for aerodynamic research in the real atmosphere. Author

N67-15387# Joint Publications Research Service, Washington, D. C.

PAPERS ON RADIO WAVE PROPAGATION

4 Jan. 1967 38 p refs Transl. into ENGLISH from Tr. Izmiran (USSR), v. 29, no. 19, 1966 38 p REFS
(JPRS-39413; TT-67-30063)

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N67-15388# Joint Publications Research Service, Washington, D. C.

TESTS OF SOME METHODS FOR COMPUTING THE MAXIMUM USABLE FREQUENCIES OF COMMUNICATION LINKS USING EXPERIMENTAL DATA

V. N. Novysh-Bylinskaya *In its* Papers on Radio Wave Propagation 4 Jan. 1967 p 1–19 refs (See N67-15387 06-07)

The computational accuracies of the maximum usable frequency (MUF) for short wave radio communication links are compared for the control points method and the equal hops method. The computations of the deviations and corrections factors are described, and the results are graphed and tabulated. A difference in the experimental and computed curves of the daily variation of MUF was observed, particularly for the winter months. The control points method was considered preferable for radio links exceeding 4000 km. The method of computing MUF for single hop links was found to be insufficiently accurate. It was determined that one correction factor cannot be used for all hours of the day and for all seasons. N.E.N.

N67-15389# Joint Publications Research Service, Washington, D. C.

COMMUNICATION AT FREQUENCIES EXCEEDING THE MAXIMUM USABLE FREQUENCIES IN THE PRESENCE OF E-LAYER SCATTERING

Ye. M. Kovaleskaya *In its* Papers on Radio Wave Propagation 4 Jan. 1967 p 20–33 refs (See N67-15387 06-07)

The possibility of high frequency radio wave propagation caused by E-layer scattering is discussed, and an estimate of the excess and field strength computations are presented. The increases of the maximum usable frequency (MUF) by reflection from the F-2 layer with single and double scattering of radio wave energy by inhomogeneities in the region of the E layer are described. A formula is derived for effective scattering cross section in the ionosphere, and the method for determining the field strength at the reception point is outlined. It was concluded that frequencies exceeding the MUF by 5%–10% can be attributed to single scattering in the E layer, and that a 40%–50% increase may be attributed to double scattering. N.E.N.

N67-15418# CBS Labs., Stamford, Conn.

TRANSDUCER AND INTERPHONE SYSTEM FOR OPERATION IN HIGH-AMBIENT NOISE Final Report, Jun. 1964–Mar. 1966

Allan J. Rosenheck, Alfred L. DiMattia, Richard G. Allen, and Emil L. Torick. 15 Jul. 1966 125 p refs
(Contract DA-28-043-AMC-00257(E))
(Rept.-6; AD-642419) CFSTI: HC $3.00/MF $0.65

Efforts are described toward development of an improved transducer and interphone system for operation in high ambient noise. Performance of the present, operational system is evaluated. Results are given for noise surveys performed on typical armored vehicles, with determinations of sound pressure level and spectrum of this noise. Following this research, an effective voice communication system for use in high ambient noise fields was developed, as described in this report, whose performance and theory of operation are detailed, with recommendations for further development work. Author (TAB)

N67-15437# United Kingdom Atomic Energy Authority, Culham (England). Research Group.

A SIMPLE 4MM MICROWAVE RECEIVER FOR PLASMA SCATTERING EXPERIMENTS

E. S. Hotston Jul. 1966 14 p refs
(CLM-P112) CFSTI: HC $3.00/MF $0.65

A microwave receiver working in the 4 mm band has been developed for use in plasma scattering experiments. The receiver has a bandwidth of 6 Mc/s and an integrating time of 1 μsec. The measured sensitivity (unity signal-to-noise ratio) was 2×10^{-10} W. This sensitivity could be improved by a factor of 1200 as the result of component development. The receiver is simple in construction and does not require a separate local oscillator. Author

N67-15456*# Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.

INSTRUCTION MANUAL FOR HRIR MODIFICATIONS TO THE APTS GROUND STATIONS USING MUIRHEAD FACSIMILE RECORDERS

22 Feb. 1966 58 p refs
(Contract NAS5-667)
(NASA-CR-81187; AED-M-2065) CFSTI: HC $3.00/MF $0.65
CSCL 09F

To record the Nimbus spacecraft high resolution infrared (HRIR) data on the Muirhead Facsimile Recorder (Mufax), installation, operation, and maintenance instructions are presented for the modification kit used to convert the automatic picture transmission (APT) ground station. The modification kit, consisting of a

marking-current kit, an adapter cable, a power cable, the HRIR converter, and the reduction gear train, provides the circuitry required to process the HRIR signals received by the Mufax detector. Automatic as well as manual operating instructions are given. R.Li.

N67-15522*# Harvard Univ., Cambridge, Mass. Gordon McKay Lab.
THE TRAVELING-WAVE V-ANTENNA
Keigo I Izuka and Ronald W. P. King Mar. 1965 19 p refs
(Grant NsG-579)
(NASA-CR-81184; SR-4) CFSTI: HC $3.00/MF $0.65 CSCL 09F

An antenna which is a combination of the resonant V-antenna and the traveling-wave dipole antenna was studied both theoretically and experimentally. The universal curves which are useful for determining the values of the length of the antenna arms, apex angle, and loading resistors are presented. The theoretical curves for the radiation pattern agree in a general sense with those of experiments. The antenna has a pencil-beam radiation pattern. The two-wavelength long traveling-wave V-antenna has a gain 10.5 times as large as that of a half-wave dipole. Author

N67-15524*# Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.
INSTRUCTION MANUAL FOR THE HRIR MODIFICATIONS TO THE APTS GROUND STATIONS USING FAIRCHILD FACSIMILE RECORDERS
10 Jan. 1966 72 p ref
(Contract NAS5-667)
(NASA-CR-81182; AED-M-2069) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Instruction and information necessary to install, operate, and maintain the modifications required to convert automatic picture transmission (APT) ground stations for processing high resolution infrared (HRIR) signals is presented. This modification kit is to provide each field location with the capability of recording the Nimbus spacecraft HRIR data on a facsimile recorder. Operating principle, test and alignment procedure, engineering drawings, and complete technical details are included. R.Li.

N67-15551*# National Aeronautics and Space Administration, Washington, D. C.
REMARKS ON THE DOPPLER RADAR MEASURING METHOD FOR INTERIOR BALLISTICS MEASUREMENTS [BEMERKUNGEN ZUR DOPPLERRADAR-MESSMETHODE FUER INNENBALLISTISCHE MESSUNGEN]
G. Schultze Dec. 1966 21 p Transl. into ENGLISH of Inst. Franco-Allemand de Rech. Tech. Note 40/64, 3 Dec. 1964
(NASA-TT-F-10608) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Circuits, methods, and results of the Doppler radar arrangement for measuring interior ballistics are given. An amplifier developed for registering the Doppler shift permits precise evaluation through conversion of sine oscillations into sharply defined impulses, and also interpolation through time- and location-dependent registration signals. Author

N67-15676* Motorola, Inc., Scottsdale, Ariz. Government Electronics Div.
S-BAND LABORATORY TEST EQUIPMENT Final Report
W. E. Michel 6 Dec. 1966 58 p
(Contract NAS9-5939)
(NASA-CR-65570) CFSTI: HC $3.00/MF $0.65 CSCL 09F

S-band transponder laboratory test equipment, which combines elements of the Apollo Block II STE with a high performance monopulse tracking receiver, was designed, built, and tested. The equipment as built achieved its original design goals. Equipment improvements were incorporated which offer greater testing flexibility and maintainability. The improvements include the addition of a ranging receiver input to permit interfacing to the PM/FM receiver and the PM test receiver, addition of convenience outlets on the circuit breaker panel, packaging of the PM/FM receiver including the RF head in a single equipment rack, redesign of the PM/FM receiver RF head to cover the range of 2090 to 2300 MHz without removal and replacement of varactor multipliers, redesign of the PM/FM receiver to incorporate "P" module standard RF circuits, and redesign of the cross correlation circuits in the PM/FM receiver to improve reliability and performance stability. The design goal of channel selection on the PM/FM receiver by means of an external frequency synthesizer was not achieved. Test results for the equipment are appended. R.N.A.

N67-15745*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MULTIPACTOR EFFECTS: SECONDARY ELECTRON EMISSION
H. Erpenbach *In its* Space Programs Sum. No. 37-41, Vol. IV 31 Oct. 1966 p 207-208 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

Investigations of reduced secondary electron emission from copper surfaces are discussed. A technique for processing copper surfaces by allowing the temperature of the copper target to rise to 500-600°C during the argon etching cycle, instead of maintaining tap water temperature is described, and a graph is presented which shows the secondary electron emission coefficient versus voltage for a surface processed by this method. The yield obtained was the lowest for a surface that has been exposed to atmosphere for an extended period. It is noted that electrical resistance measurements on the target surfaces, using a four terminal network, show no differences between a freshly polished copper target and one that was carbonized. A.G.O.

N67-15746*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
OPTICAL COMMUNICATIONS ELEMENTS: SIMULATED ATMOSPHERE
W. H. Wells *In its* Space Programs Sum. No. 37-41, Vol. IV 31 Oct. 1966 p 209-212 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

Simple statistical models have been used in a computer program to simulate loss of coherence in order to estimate the effect of the atmosphere on a laser receiver. The random variable being considered is the peak light intensity at any point in the blurred focal point of a large aperture telescope. Resulting data were used to plot contour maps of the focal patterns for arbitrary but equally spaced units of intensity near the peak values. A.G.O.

N67-15747*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A HYBRID MICROELECTRONIC ANALOG TO DIGITAL CONVERTER
D. M. Bergens *In its* Space Programs Sum. No. 37-41 Vol. IV 31 Oct. 1966 p 213-216 refs (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

An analog to digital converter (ADC) which operates on the principle of successive approximation, quantizing the input voltage into an 8-bit binary number is described. Emphasis is placed on an investigation of the feasibility of using hybrid thin film techniques to manufacture an ADC suitable for spacecraft use. Consideration is given to operation, fabrication, fabrication problems, and electrical performance of the ADC. A.G.O.

N67-15749*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RADAR ALTIMETER AND DOPPLER VELOCITY SENSOR, FREQUENCY DISCRIMINATOR ANALYSIS
R. L. Horttor *In its* Space Programs Sum. No. 37-41, Vol. IV 31 Oct. 1966 p 225-228 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

The operation of the Surveyor radar altimeter and doppler velocity sensor (RADVS) is analyzed for a case in which both signal and noise are gaussian. The analysis shows that the RADVS discriminator responds to the centroid of the input cross power spectrum. Therefore, if the spectrum is unsymmetric, as caused by terrain biasing or mixer flicker noise, the output will be biased away from the true doppler frequency. Whether the error is sufficient to cause difficulty depends on the application. A.G.O.

N67-15751*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
APPROXIMATE ANALYSIS OF A FREQUENCY-SHIFT KEYED SYSTEM WITH UNCERTAINTY IN THE CARRIER FREQUENCY
D. W. Boyd *In its* Space Programs Sum. No. 37–41, Vol. IV 31 Oct. 1966 p 233–239 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

The performance of the receiver in a frequency shift keyed (FSK) telemetry system (in which performance is traded for simplicity) is analyzed; and the probability of error for the system is calculated, using an approximation for the square law output of the integrator. It is assumed that bit synchronization is available at the receiver. A block diagram of the proposed system is depicted. As an identical result, the signal-to-noise ratio at the integrator output is also calculated. L.S.

N67-15752*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
HIGH IMPACT ANTENNA STUDY: CAVITY-BACKED SPIRAL ANTENNA
K. Woo *In its* Space Programs Sum. No. 37–41, Vol. IV 31 Oct. 1966 p 239–241 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

An indirect impact test of an experimental model of a cavity-backed spiral antenna showed that the antenna sustained a 10,000 g shock without visible physical damage or marked degradation in electrical performance. Radiation patterns of the left and right circularly polarized waves taken before and after the impact at 2298 MHz are depicted. The decrease in gain (from 4.8 to 4.2 db) and a corresponding increase in input VSWR (from 1.87 to 2.70) are attributed to the loosening of the ground contact between the locking nut and the spiral arm. The results indicate, that with further improvements, this type of antenna can be used as an indirect impact survival antenna. Work is in progress to strengthen the feed contacts and to refine the electrical performance. L.S.

N67-15754*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMBINATORIAL COMMUNICATIONS: THE TARGET LEMMA
E. Rodemich *In its* Space Programs Sum. No. 37–41, Vol. IV 31 Oct. 1966 p 248–250 ref (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

A geometric property of the multivariate Gaussian distribution is proved, in a quite general setting. The result is needed in detection theory and data compression. The lemma proved is called the target lemma because it states that if an archer has to hit a convex symmetric target, and his error distribution is also convex and symmetric about his aiming point, he should aim for the center of the target to maximize his probability of hitting it. L.S.

N67-15755*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMBINATORIAL COMMUNICATIONS: PRIMATIVE TRINOMIALS OF HIGH DEGREE
E. Rodemich and Howard Rumsey, Jr. *In its* Space Programs Sum. No. 37–41, Vol. IV 31 Oct. 1966 p 250–251 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

New primitive polynomials of high degree were found by testing the trinomials $P(x) = x^n + x^p + 1$, with $1 \leq p < n/2$, for primitivity using various Mersenne exponents n. All Mersenne exponents n from 127 to 2281 (127; 521; 607; 1279; 2203; and 2281) along with their corresponding values of p which are less than n/2 such that P(x) is primitive, are listed in a table. The previous high was degree 127 with $x^{127} + x + 1$. There are no primitive trinomials for the Mersenne exponent 2203. Such trinomials are useful for generating pseudorandom sequences of 0's and 1's of long length for combinatorial communications. L.S.

N67-15756*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMBINATORIAL COMMUNICATIONS: NOTE ON EXISTENCE CRITERIA FOR CYCLIC DIFFERENCE SETS
L. D. Baumert and Howard Rumsey, Jr. *In its* Space Programs Sum. No. 37–41, Vol. IV 31 Oct. 1966 p 251–253 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

Mathematical proofs of four existence criteria for cyclic difference sets are presented to establish the dependency of these criteria on Yamamoto's criterion. The latter criterion states that in a cyclic difference set with parameters v, k, and λ, for all prime divisors p of n and prime divisors q of v, if $p^f \equiv -1 \pmod{q}$ for an integer $f > 0$ then the integer e is even, where p^e divides n and p^{e+1} does not divide n. Cyclic difference sets are used to derive many of the codes used in digital communications. L.S.

N67-15757*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PROPAGATION STUDIES: ON DECISION-DIRECTED SUBCARRIER PHASE ESTIMATION
J. W. Layland *In its* Space Programs Sum. No. 37–41, Vol. IV 31 Oct. 1966 p 254–264 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

The behavior of both maximum-likelihood and most-likely-word decision-feedback computer modes of phase sign estimation was computer simulated, using Monte Carlo evaluation of the signal transfer coefficient (STC) for transorthogonal K-bit codes, $1 \leq K \leq 6$. Results are graphically depicted. They indicate that a phase estimator with decision-directed feedback can perform with relatively high efficiency when used with a coded PSK telemetry system and an arbitrarily long code. Contrarily, the efficiency of a squaring loop with coded signals decreases monotonically to zero as code length increases, thus severely limiting its usefulness. Theoretical results regarding bounds on the STC for 5-bit and 8-bit transorthogonal codes are also presented. L.S.

N67-15760*# Jet Propulsion Lab., Calif. Inst. of Tech. Pasadena.
DIGITAL COMMUNICATION AND TRACKING: LIMIT-CYCLES IN PASSIVE-FILTER PHASE-LOCKED LOOPS
R. C. Tausworthe *In its* Space Programs Sum. No. 37–41, Vol. IV 31 Oct. 1966 p 268–270 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

Viterbi's result in the development of an approximate upper bound for the largest doppler phase function possible with a passive second order loop is extended to obtain a formula valid over the entire range and valid for any order passive loop filter, subject to a particular restriction. As a check, it is shown that the theorem agrees not only asymptotically with Viterbi's result, but also gives the exact first-order results. A.G.O.

N67-15761*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DIGITAL COMMUNICATION AND TRACKING: THE MEAN-SQUARE APPROXIMATION TO THE OPTIMUM CROSS-CORRELATION FUNCTION
J. J. Stiffler *In its* Space Programs Sum. No. 37–41, Vol. IV 31 Oct. 1966 p 270–272 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

The optimum cross-correlation function is approximated for a device such as the phase locked loop, designed to track a null in the cross-correlation between a received and a locally generated signal. Although the mean-square criterion used in this study is quite arbitrary, it is concluded that the optimal tracking cross-correlation function remains the square wave, regardless of the signal-to-noise ratio. A.G.O.

N67-15762*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DATA COMPRESSION DEVELOPMENT: A COMPARISON OF TWO FLOATING-APERTURE DATA COMPRESSION SCHEMES
J. C. Wilson *In its* Space Programs Sum. No. 37-41, Vol. IV 31 Oct. 1966 p 273-278 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

A comparison is presented between two data compression schemes, zeroth-order and first-order, which operate directly on data that would normally be transmitted in an uncompressed mode. The range of compression ratios available with each method was obtained by performing the schemes on a random signal. Experimental results are shown which graphically display typical behavior with changes in aperture-width and sample spacing. It is demonstrated that the first-order data compression scheme is generally superior to the zeroth-order method. A.G.O.

N67-15784*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACECRAFT ANTENNA POINTING
G. E. Fleischer *In its* Space Programs Sum. No. 37-40, Vol. 4 31 Aug. 1966 p 16-19 (See N67-15781 06-34) CFSTI: HC $3.00/MF $0.65

A two degree of freedom pointing system is examined with respect to its geometry, errors caused by attitude drift, and methods of correcting antenna position for attitude drift using sensor error signals. Equations are derived for the unit hinge axis vector, hinge and swivel angle error correction, and for correcting the antenna pointing angles by adding pitch and yaw error signals and ignoring roll errors. Figures are included to depict the location of the hinge axis and swivel axis relative to body-fixed areas, the earth coordinates for a 512-day Jupiter flyby, the nominal antenna hinge and swivel angles for Jupiter flyby, and the maximum pointing errors due to spacecraft attitude misalignments. M.G.J.

N67-15812*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A SYSTEM REORGANIZATION OF THE SPACECRAFT DATA ENCODER
J. R. Kinkel *In its* Space Programs Sum. No. 37-40, Vol. 4 31 Aug. 1966 p 143-154 (See N67-15781 06-34) CFSTI: HC $3.00/MF $0.65

The spacecraft multiplexer must be capable of failing gracefully in the presence of catastrophic component failures. The probability that failures will corrupt sources of information increases sharply with the number of sensors to be multiplexed. To localize these failures, a new system organization and its implementation were investigated simultaneously. Two techniques were applied to achieve partial degradation on the Mariner C multiplexer: double addressing and short counting. Double addressing occurs when a switch on one multiplexer deck controls another deck of switches. Any one sensor on the subdeck must be addressed by two switches to be sampled. Short counting occurs because the analog switches are sequenced by a shift register. When shifting fails in midregister, all analog switches beyond the failed stage cannot be addressed. Both techniques permit failure localization; however, an attempt is made to find more graceful methods of degradation. R.N.A.

N67-15814*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ON THE SPECTRUM OF SINGLE-SIDEBAND PHASE MODULATION BY NORMAL NOISE
J. C. Springett *In its* Space Programs Sum. No. 37-40, Vol. 4 31 Aug. 1966 p 163-169 (See N67-15781 06-34) CFSTI: HC $3.00/MF $0.65

The conditions necessary to achieve exact single-sideband phase modulation were explored and the second moment function for a Gaussian modulating signal was derived. Calculations for some specific modulating spectral shapes showed that bandwidth savings of 40% can be achieved even for high modulation index. As a result, the use of single-sideband might alleviate problems encountered when double-sideband modulation approaches the bandwidth constraint. Author

N67-15816*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ANTENNA STRUCTURES: EVALUATION TECHNIQUES OF REFLECTOR DISTORTIONS
M. S. Katow and L. W. Schmele *In its* Space Programs Sum. No. 37-40, Vol. 4 31 Aug. 1966 p 176-184 refs (See N67-15781 06-34) CFSTI: HC $3.00/MF $0.65

Recent modifications to the root mean square (RMS) computer program, a technique used to evaluate the distortion of the reflective surface of an antenna, have decreased the input data requirements and improved the accuracy and clarity of the answers. The RMS figure can be used to evaluate the individual normal error and path length change outputted at each joint in conjunction with the contour charts for structural corrective actions. Also, RF boresight directions can be calculated from the outputted vertex position and rotation of the symmetrical axis of the best fitting paraboloid based on known RF feed position. The history and a review of the basic formulations of the RMS program are presented along with discussions of the reduction of field data, analytical data inputs, output, RF boresight determination, and contour levels plots. R.N.A.

N67-15817*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RF TECHNIQUES: 90-Gc MILLIMETER WAVE WORK
C. T. Stelzried and W. V. T. Rusch *In its* Space Programs Sum. No. 37-40, Vol. 4 31 Aug. 1966 p 185-190 (See N67-15781 06-34) CFSTI: HC $3.00/MF $0.65

Millimeter wave components and techniques are being investigated to determine their future applicability to space communications and tracking. This work involves the development of instrumentation for accurate measurements of insertion loss, VSWR, power, and equivalent noise temperatures. Millimeter wave circuit elements are being evaluated in a radio telescope system consisting of a 60-in antenna and a superheterodyne radiometer. An effort was made to determine an estimate for the overall input signal attenuation due to the losses of the antenna surface, horn, and input waveguide. The Deep Space Network receiving antennas are painted with a special low loss white plastic paint having long life and low spectral gloss which minimizes heating of the subreflector caused by the sun. The 60-in milimeter searchlight antenna was painted with a zinc chromate undercoat and the special high reflectance paint in order to perform solar observations. An attempt was made to place an upper bound on the total radiometetric input resistive losses as determined from radiometric observations. R.N.A.

N67-15818*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RF TECHNIQUES: MISMATCH ERRORS ON NOISE TEMPERATURE MEASUREMENTS
T. Y. Otoshi *In its* Space Programs Sum. No. 37-40, Vol. 4 31 Aug. 1966 p 190-197 refs (See N67-15781 06-34) CFSTI: HC $3.00/MF $0.65

The general case equations applicable to the mismatch errors in Y-factor measurements are presented for calibration of a receiver and also any unknown noise source which is connected to the receiver through a two port network. Several examples are also given which use reflection coefficients and typical Y-factors measured on the Mars Deep Space Station listening cone system.
Author

N67-15819*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LOW DATA RATE TELEMETRY RF SYSTEM DEVELOPMENT
R. B. Postal and C. M. Potts *In its* Space Programs Sum. No. 37-40, Vol. 4 31 Aug. 1966 p 198–201 (See N67-15781 06-34) CFSTI: HC$3.00/MF$0.65

The circuitry and developmental status are described for a solid state transmitter being developed as a subassembly for a telecommunication system capable of surviving a high impact on a lunar or planetary surface. Major development considerations are resistance to high impact levels and sterilizability. The transmitter will generate a level of 3 w minimum at 2295 MHz with a direct current to radio frequency conversion efficiency of 10%. Design goals are tabulated.
R.N.A.

N67-15820*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
HIGH IMPACT ANTENNA STUDY: COAXIAL CAVITY RADIATOR
K. Woo *In its* Space Programs Sum. No. 37-40, Vol. 4 31 Aug. 1966 p 201–206 refs (See N67-15781 06-34) CFSTI: HC $3.00/MF$0.65

S-band low gain circularly polarized high impact antennas are being developed for planetary landing missions. One such antenna, a coaxial cavity radiator, has been found capable of meeting the electrical requirements as well as withstanding direct high impact applied to its radiating aperature. Results of high impact tests performed on the antenna showed that despite a bruised cavity surface and a deformed aperture, the antenna's electrical performance deteriorated very little. Radiation patterns before and after impact are shown. On the basis of the results, it was concluded that the antenna would have survived an actual landing if the same physical damage had been inflicted on it by the landing impact.
R.N.A.

N67-15821*# University of Southern Calif., Los Angeles. Dept. of Electrical Engineering.
COMBINATORIAL COMMUNICATIONS: SEARCH FOR CYCLIC HADAMARD MATRICES
R. Thoene and S. W. Golomb *In* JPL Space Programs Sum. No. 37-40, Vol. 4 31 Aug. 1966 p 207–208 Prepared for JPL (See N67-15781 06-34) CFSTI: HC$3.00/MF$0.65
(Contract JPL-951016)

Results of an effort to determine the existence of cyclic Hadamard matrices are presented for values of N which were heretofore unsettled. Results show that although many irregularities occur, the number of cosets generated for a particular value of N generally increases as N grows in size. This fact and the increased length of the generated sequences for larger values of N combine to increase computer time required to settle the issue for larger matrices. The cases considered were confined to $N \leq 1000$. Even then, 54 of the 250 cases could not be tested due to the large computer time requirements. Of the 196 remaining cases, 95 had already been settled by virtue of N–1 being prime or a twin prime product, or N being a power of 2. The 101 cases which could be tested in a reasonable length of computer time revealed that no cyclic Hadamard matrix derivable from a difference set exists for these values.
R.N.A.

N67-15822*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMBINATORIAL COMMUNICATIONS: ENUMERATION OF A SPECIAL CLASS OF PERMUTATIONS
R. Stanley *In its* Space Programs Sum. No. 37–40, Vol. 4 31 Aug. 1966 p 208–214 (See N67-15781 06-34) CFSTI: HC $3.00/MF$0.65

Let π be a permutation $a_1 a_2 \ldots a_n$ of the symbols 1,2, ... ,n. We say that π contains a run of length t, if for some i and k, $1 \leq i \leq n$, $1 \leq k \leq n$, we have $a_i = k$, $a_{i+1} = k+1$, ... , $a_{i+t-1} = k+t-1$. All numbers are regarded as taken mod n; for instance, the permutation 235461 contains the run 6123 of length 4. Let F(n,t) denote the number of permutations of 1,2, ... , n which contain no runs of length t (or greater). Our object is to estimate the function F(n,t) for fixed t. We consider the case $t=2$. We obtain a recurrence relation for F(n,2), compute its generating function, give a closed expression for it, and derive its complete asymptotic expansion. In particular we show that the probability that a random permutation of 1,2, ... , n has no runs of length 2, approaches 1/e as $n \to \infty$. The situation becomes more complicated when $t>2$. We are unable to give as exact results as obtained for $t=2$, but use of the principle of inclusion and exclusion enables us to develop a method which yields the asymptotic expansion of F(n,t). Here we get the probability that a random permutation of 1,2, ... , n has no runs of length t, $t>2$, approaches 1 as $n \to \infty$.
Author

N67-15823*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
CODING THEORY: MOMENTS OF WEIGHT DISTRIBUTIONS
R. Stanley *In its* Space Programs Sum. No. 37–40, Vol. 4 31 Aug. 1966 p 214–216 ref (See N67-15781 06-34) CFSTI: HC$3.00/MF$0.65

A general combinatorial formula is developed which allows calculation of sums of the type
where S is a set of vectors v, $\sigma(v)$ is the sum of the coordinates of v, and r is an integer depending on a special property of the set S. This formula is applied to (n,k) binary codes and yields explicit formulas for the sums
where a_i words of the code have weight i, and d is the minimum weight of the dual code. When enough information about a code is known, these equations may suffice to determine its weight distribution. As an example, the weight distribution of the dual Golay code is calculated without using J. MacWilliams' formula.
Author

N67-15824*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
CODING THEORY: EFFICIENT SOLUTIONS OF EQUATIONS FOR DECODING
R. Mc Eliece *In its* Space Programs Sum. No. 37-40, Vol. 4 31 Aug. 1966 p 216–218 refs (See N67-15781 06-34) CFSTI: HC$3.00/MF$0.65

Berlekamp, Rumsey, and Solomon presented methods of solving certain algebraic equations over finite fields of characteristic 2; such equations turn up in decoding procedures for Bose–Chaudhuri codes. This paper gives a more general approach to the same problem, and succeeds in giving explicit solutions to many questions. The solutions are easily mechanized. It is shown how these solutions represent a considerable saving of effort over previous methods.
Author

N67-15825*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
CODING THEORY: THE INDEX OF COMMA FREEDOM IN ITERATIVE CODES
J. Stiffler *In its* Space Programs Sum. No. 37-40, Vol. 4 31 Aug. 1966 p 218–219 ref (See N67-15781 06-34) CFSTI: HC$3.00/MF$0.65

Iteration is one method of constructing large error correcting code dictionaries by combining several smaller ones. One of the chief advantages of these codes is in the relative simplicity of the associated decoding algorithm. Generally, it is no more difficult to decode the iterated code than to decode each of the codes which were combined to produce it. Another feature of iterated codes is the propagation of the comma free properties of the component codes. The discussion shows that the index of comma freedom grows essentially as rapidly as the length of the code words in the process of iteration. Author

N67-15826*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DIGITAL COMMUNICATION AND TRACKING: CALCULATION OF RANGE-CLOCK JITTER
R. C. Tausworthe *In its* Space Programs Sum. No. 37-40, Vol. 4 31 Aug. 1966 p 219–225 (See N67-15781 06-34) CFSTI: HC $3.00/MF $0.65

Two effects in a ranging clock tracking loop are discussed which must be considered before an accurate analysis of clock jitter for a ranging subsystem can be made. First is the RF carrier reference loop jitter which degrades the ranging sideband power. In the second, clock loop jitter causes a certain amount of range code decorrelation which alters the clock loop S-curve. A cascade loop model of a ranging receiver is considered. The affects of both reference jitter and clock loop jitter are computed. As an illustration, the clock loop performance of the Mark I ranging system is computed. Loop parameters, the acquisition profile, and the resulting theoretical performance for each stage in the acquisition procedure are shown. It is shown that at very low signal levels, better tracking results with 77.5% to 53% correlation than with the full code. However, this is not the case over the useful operating range. In the worst case, i.e., during first component acquisition, about 12 to 13 dB separate the performance of the carrier loop from that of the clock loop in terms of input power. R.N.A.

N67-15829*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMMUNICATION SYSTEMS DEVELOPMENT: PROBABILITY DISTRIBUTIONS AND ERROR RATES IN SPACECRAFT RECEIVERS
W. Lindsey *In its* Space Programs Sum. No. 37-40, Vol. 4 31 Aug. 1966 p 230–235 refs (See N67-15781 06-34) CFSTI: HC $3.00/MF $0.65

Spacecraft data demodulators must be tested prior to flight and its performance reliability verified before becoming a part of the overall system. Due to the low error probability, the time required to establish experimentally whether or not the theoretically specified error rate is obtained at the specified signal-to-noise ratio (SNR) is several hours. If an actual experimental curve of error probability versus SNR is desired, the amount of test time becomes prohibitive. An approach is presented which would reduce the testing time by developing analytical expressions which specify the required probability distributions in terms of the system parameters. The parameters of this distribution could be measured in the laboratory and used to determine the error probability. R.N.A.

N67-15899*# Harvard Univ., Cambridge, Mass. Gordon McKay Lab.
A COMPARISON BETWEEN THE VARIATIONAL SOLUTION AND THE EXPERIMENTAL DATA
Liang-Chi Shen Sep. 1966 15 p refs
(Grant NsG-579)
(NASA-CR-81239; SR-7a) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Using the variational principle, a simple trial function was found for the current distribution on the antenna with nonreflecting resistive loading so that it agrees with the experimental data of the input admittance, the amplitude of the current distribution, and the radiation field pattern in the entire frequency range 450 to 900 MHz. Author

N67-15901*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-42, VOLUME III FOR THE PERIOD SEPTEMBER 1, 1966 TO OCTOBER 31, 1966. DEEP SPACE NETWORK
30 Nov. 1966 138 p refs
(Contract NAS7-100)
(NASA-CR-81209; JPL-SPS-37-42, Vol. III) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Summary data on the research and development activities pertaining to the Deep Space Network are presented. The main areas covered pertain to tracking and navigational accuracy analyses, communications, communications engineering, and deep space station engineering and operations. M.G.J.

N67-15902*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DSN INHERENT ACCURACY PROJECT
T. W. Hamilton and D. W. Trask *In its* Space Programs Sum. No. 37-42, Vol. III 30 Nov. 1966 p 3 (See N67-15901 06-07) CFSTI: HC $3.00/MF $0.65

Objectives and efforts to coordinate and initiate relevant activities of the Deep Space Network (DSN) Inherent Accuracy Project, are discussed. S.C.W.

N67-15903*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
EFFECT OF CONSTANT ACCELERATION ON THE INFORMATION CONTENT OF A SINGLE PASS OF DOPPLER DATA
T. Nishimura *In its* Space Programs Sum. No. 37–42, Vol. III 30 Nov. 1966 p 3–7 (See N67-15901 06-07) CFSTI: HC $3.00/MF $0.65

Reported is an analysis of the extent to which a small constant acceleration acting on a spacecraft (solar pressure, gas leakage) will affect estimates of the mean geocentric radial velocity, its right ascension, and the cosine of its declination. Emphasized is the effect on the cosine of declination of the spacecraft's trajectory. It is assumed that the spacecraft is moving away from the Earth with an almost straight line motion while the observer (tracking station) is rotating around the z-axis at a distance r_s. It was found that: (1) The variances associated with the estimate of the geocentric radial velocity and the right ascension, are not affected by the constant acceleration because the even functions 1 and cos θ over $-\psi \leq \theta \leq \psi$ are orthogonal to the odd function θ. (2) The variance associated with the estimate of the cosine of declination is severely degraded by the presence of constant acceleration because the odd function sin θ is nonorthogonal to the odd function θ over $-\psi \leq \theta \leq \psi$. This indicates that a small acceleration acting on the spacecraft in the radial direction may seriously damage the precision of the cosine of declination. Results were in agreement with previously reported studies which indicated that the velocity parallax effect due to the rotation of the ground station around the Earth's spin axis plays a dominant role in the orbit redetermination when the information is supplied by a single pass of doppler data from a distant spacecraft. S.C.W.

N67-15908*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THEORETICAL BASIS FOR THE DOUBLE PRECISION ORBIT DETERMINATION PROGRAM. V DOPPLER AND RANGE OBSERVABLES
T. D. Moyer *In its* Space Programs Sum. No. 37–42, Vol. III 30 Nov. 1966 p 15–21 (See N67-15901 06-07) CFSTI: HC $3.00/MF $0.65

The theoretical basis for the double precision orbit determination program, and the formulation for computing two-way Doppler and round-trip range in light seconds, are presented. The formulation requires the solution to the light time problem; namely, the heliocentric position, velocity, acceleration, and jerk vectors of each participant evaluated at its epoch of participation. The rectangular components of each vector are referred to the mean Earth equator and equinox of 1950.0. The participants are the

tracking station at the reception time t_3 (midpoint of the count interval T_c for Doppler), the probe at its reception/transmission time t_2, and the tracking station at its transmission time t_1. The light time problem is solved in ephemeris time, and the round-trip time is converted to station time using previously published time transformations. S.C.W.

N67-15908*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FREQUENCY GENERATION AND CONTROL: ATOMIC HYDROGEN FREQUENCY STANDARD
W. H. Higa *In its* Space Programs Sum. No. 37-42, Vol. III 30 Nov. 1966 p 24–25 (See N67-15901 06-07) CFSTI: HC $3.00/MF $0.65

Reported is the design of a dual channel traveling wave maser which will be integrated into a closed-cycle refrigerator. System specifications are briefly described and an illustration of the assembly is included. S.C.W.

N67-15909*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
IMPROVED RF CALIBRATION TECHNIQUES: DAILY SYSTEM NOISE TEMPERATURE MEASUREMENTS
C. T. Stelzried *In its* Space Programs Sum. No. 37-42, Vol. III 30 Nov. 1966 p 25–32 (See N67-15901 06-07) CFSTI: HC $3.00/MF $0.65

Reported is a refinement to the daily noise temperature calibration technique used at the Mars and Venus stations which consists of a follow-up temperature contribution measurement for each calibration with a maser off-on Y-factor measurement. The follow-up contribution defined at the maser input measured by turning the maser off with the input connected to the ambient termination is given to good approximation by $T_F = (Tm + To)/(Y - 1)$ where T_M = maser noise temperature defined at the maser input, °K; T_o = ambient termination temperature, °K; Y = receiver output noise ratio between maser on and off. The receiver noise temperature defined at the maser input is then given by $T_R = T_M + T_F$. A revised calibration sheet, 1620 computer program (modified), and sample print-out are illustrated. Principal results of the daily noise temperature calibration for the period July 12 to October 24, 1966 are tabulated for the Venus and Mars stations. The average system noise temperatures and reported maser gains for this period are also tabulated. S.C.W.

N67-15910*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
IMPROVED RF CALIBRATION TECHNIQUES: WEEKLY NOISE TEMPERATURE CALIBRATIONS
T. Y. Otoshi *In its* Space Programs Sum. No. 37–42, Vol. III 30 Nov. 1966 p 32–37 (See N67-15901 06-07) CFSTI: HC $3.00/MF $0.65

Periodic calibrations of the absolute receiver and antenna temperatures as well as calibrations of gas tube excess temperatures for the Mars Deep Space Station (DSS) and Venus DSS antenna systems were continued on a weekly basis. To obtain an absolute calibration of receiver temperature, or to separate system temperature into its antenna and receiver temperature components, a second thermal noise standard (cryogenic load) was used. Results of weekly noise temperature calibrations are presented in terms of the components of system temperature. Data indicated that problems were being encountered in weekly calibrations and a study was conducted to determine several possible causes of errors. Special tests were made to determine the effects of changing detector bias voltage settings, pressurizing and not pressurizing the liquid nitrogen load with helium gas, and venting and not venting the cryogenic dewar to the atmosphere. It was established that the detector bias should be set at approximately 4.0 mv for linearity reasons, and the cryogenic dewar should always be vented to the atmosphere. An analysis of probable errors and mismatches indicated that for calibration of low-noise receiver and antenna temperatures, a waveguide liquid helium-cooled load would be more accurate than a liquid nitrogen-cooled load. S.C.W.

N67-15911*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
EFFICIENT ANTENNA SYSTEMS: CALCULATED GAIN OF THE ADVANCED ANTENNA SYSTEM
A. C. Ludwig *In its* Space Programs Sum. No. 37-42, Vol. III 30 Nov. 1966 p 37–40 (See N67-15901 06-07) CFSTI: HC $3.00/MF $0.65

The gain of a 210-ft diameter antenna with uniform aperture illumination at 2295 is 63.75 dB. Expected gain of the real antenna is computed by evaluating the effect of deviations from the ideal antenna. Included is an analysis of losses due to (1) nonuniform aperture illumination and spillover; (2) aperture shadowing or blockage by the subreflector and its support structure (quadripod); and (3) deviations of the reflecting surfaces from a perfect paraboloid or hyperboloid, including misalignment or defocusing of the feed and subreflector. Results of error analyses based on estimates for each loss component believed to have a 95% probability of bracketing the true value are presented. Results showed that the dominant uncertainty was due to blockage, which was attributed to the uncertainty in the opacity factor. S.C.W.

N67-15912*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
EFFICIENT ANTENNA SYSTEMS: X-BAND GAIN MEASUREMENTS
D. A. Bathker and G. S. Levy *In its* Space Programs Sum. No. 37-42, Vol. III 30 Nov. 1966 p 40–42 (See N67-15901 06-07) CFSTI: HC $3.00/MF $0.65

The initiation of an experimental program designed to study the behavior of the Deep Space Instrumentation Facility (DSIF) antennas as they approach gain limit, is reported. Gain measurements have been made at S-band, and measurements at x-band are planned. An x-band 85-ft antenna cassegrainian cone has been built and will be used to measure gain at the Venus station. The tradeoffs involved in optimizing large antennas for space communications are discussed, and the concept of gain limit which is the maximum gain a given antenna can achieve is introduced. An x-band feed system was also designed to fit in a standard DSIF cassegrainian support cone. This feed system can be used on either the 85-ft Venus station antenna or on the 210-ft advanced antenna system. The first 8448 MHz tests will be conducted at the Venus station. Measurements will also be made of the antenna temperature before and after installation on the 85-ft paraboloid to determine the spillover contribution. Measurements of celestial source temperature will be made, and these data will then be used in conjunction with the gain data to obtain absolute source flux density. After completion of the Venus station experiment, it is planned to use the proposed feed-cone at the Mars station. S.C.W.

N67-15913*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LOW NOISE RECEIVERS: MICROWAVE MASER DEVELOPMENT
S. M. Petty and R. C. Clauss *In its* Space Programs Sum. No. 37-42, Vol. III 30 Nov. 1966 p 42–46 (See N67-15901 06-07) CFSTI: HC $3.00/MF $0.65

The construction of a traveling wave maser (TWM) for use at 8448 MHz is reported. The maser provides a net gain of 41.5 db when installed in a closed-cycle helium refrigerator operating at 4.4°K, and provides more than 30 db net gain over a tunable range of 140 MHz. An equivalent input noise temperature of approximately 18°K has been measured. Data on the maser structure, the complete maser package, and performance characteristics; are included. S.C.W.

N67-15915*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DIGITAL COMMUNICATION AND TRACKING: RANGING MEASUREMENT
R. C. Tausworthe *In its* Space Programs Sum. No. 37-42, Vol. III 30 Nov. 1966 p 52–56 (See N67-15901 06-07) CFSTI: HC $3.00/MF $0.65

The ranging measurements to be made as part of the celestial mechanics experiment of the Mariner Venus 1967 mission are outlined. The ranging equipment and ground system mechanization are described in detail. Both spacecraft and ground transmitter-receiver parameters are tabulated and a schematic drawing of the ranging equipment is shown. R.N.A.

N67-15916*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DIGITAL COMMUNICATION AND TRACKING: RANGING SUBSYSTEM ACQUISITION PROBABILITIES
R. Didday *In its* Space Programs Sum. No. 37-42, Vol. III 30 Nov. 1966 p 56-60 (See N67-15901 06-07) CFSTI: HC $3.00/MF $0.65

Details are given on a technique which permits quick computation of the probability of correct acquisition in a ranging system. Information concerning the transmitter and receiver codes must be obtained in the form of length of the period of each component and the change in correlation before and after that code has been acquired. Using these probability functions, it is possible to determine if a particular system is operating properly by making a number of trials under known conditions of signal-to-noise ratio and range. Although the results presented are specifically for the Mark I ranging subsystem, the programs are general enough to allow similar results to be quickly obtained for future ranging codes. Author

N67-15917*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DIGITAL COMMUNICATION AND TRACKING: A PHASE-LOCKED ANALYSIS PROGRAM
R. C. Tausworthe *In its* Space Programs Sum. No. 37-42, Vol. III 30 Nov. 1966 p 60-61 (See N67-15901 06-07) CFSTI: HC $3.00/MF $0.65

A brief description is given of a computer program operable on an SDS-920 or SDS-930 which is capable of analyzing or designing either or both of the carrier tracking and clock tracking loops of a Deep Space Instrumentation Facility receiver. R.N.A.

N67-15918*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DIGITAL COMMUNICATION AND TRACKING: TIME SYNCHRONIZATION EXPERIMENT
W. Martin *In its* Space Programs Sum. No. 37-42, Vol. III 30 Nov. 1966 p 61-67 (See N67-15901 06-07) CFSTI: HC $3.00/MF $0.65

Results are discussed of time synchronization experiments conducted with several DSN stations. Over a two-day period the Mark I ranging system accurately measured time offsets between paired stations. The resulting clock errors were later verified when the Naval Observatory independently calibrated the stations' clocks. Author

N67-15919*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FREQUENCY GENERATION AND CONTROL: VCO NOISE MEASUREMENT AND OPTIMUM TRACKING FILTERS
C. Cooper *In its* Space Programs Sum. No. 37-42, Vol. III 30 Nov. 1966 p 67-71 (See N67-15901 06-07) CFSTI: HC $3.00/MF $0.65

A technique is described for measuring the phase noise spectral density function of a VCO and presents some experimental results obtained through the use of this technique. The accuracy obtained with these measurements seems acceptable. Using the measured spectral density function of the VCO noise, the optimum tracking filter is determined, using the method of R.C. Tausworthe. Experimental results are then presented which confirm that the tracking filter so determined is actually the optimum. Author

N67-15920*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FREQUENCY GENERATION AND CONTROL: S- AND X-BAND CENTRAL FREQUENCY SYNTHESIZER
G. U. Barbani *In its* Space Programs Sum. No. 37-42, Vol. III 30 Nov. 1966 p 71-75 refs (See N67-15901 06-07) CFSTI: HC $3.00/MF $0.65

A general report on the central frequency synthesizer performance and the results of an investigation of the 35.075 MHz voltage controlled oscillator static phase error are presented. Author

N67-15921*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
S-BAND RECEIVER-EXCITER RANGING SUBSYSTEM (RER), BLOCKS IIB AND IIIC
H. Donnelly, C. E. Johns, R. W. Tappan, and M. R. Wick *In its* Space Programs Sum. No. 37-42, Vol. III 30 Nov. 1966 p 77-83 (See X67-15901 06-07) CFSTI: HC $3.00/MF $0.65

The S-band receiver-exciter ranging subsystem Blocks IIB and IIIC provide a system with both DSN and MSFN parameters and the capability to select these parameters by switch control. The parameter differences were reduced to the reference receiver predetection and loop noise bandwidths. However, the exciter and receiver voltage controlled oscillator subassemblies still contain only four selectable channels. Block IIIC has two sets of voltage controlled oscillator subassemblies, one for the four MSFN channels and one for four DSN channels. Switching from an MSFN channel to a DSN channel or vice versa requires that the voltage controlled oscillator subassemblies installed in the subsystem be replaced with the second set. All DSN and MSFN receiver-exciter ranging subsystems are to be upgraded to Blocks II, IIB, and IIIC. R.N.A.

N67-15922*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
57/221 FREQUENCY SHIFTER—BLOCK IIB
C. E. Johns *In its* Space Programs Sum. No. 37-42, Vol. III 30 Nov. 1966 p 83-86 refs (See N67-15901 06-07) CFSTI: HC $3.00/MF $0.65

A frequency shifter was developed for the Block IIB receiver-exciter ranging subsystems to derive reference signals coherently related to the exciter voltage controlled oscillator frequency by a factor of 57/221. The reference signals are required for the doppler extractor and the coherent translator. Basic to the operation of the frequency shifter is the type of synchronized avalanche oscillator. In a comparison with the conventional locked oscillator, the avalanche oscillator maintains synchronism over a greater frequency range, has less inherent phase instability, and is less sensitive to temperature changes. Typical characteristics of the 57/221 frequency shifter subassembly using the synchronized avalanche oscillator design are: an input frequency of 21.9792 MHz, an output frequency of 5.6888 MHz, a bandwidth (controlled by crystal filter) of ±33 kHz, a lock range greater than ±2%, and a phase instability of approximately 0.01 deg rms. R.N.A.

N67-15923*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FLIGHT PROJECT SUPPORT
J. Orbison *In its* Space Programs Sum. No. 37-42, Vol. III 30 Nov. 1966 p 87-88 (See N67-15901 06-07) CFSTI: HC $3.00/MF $0.65

Deep Space Station flight support operations for the Surveyor II, Lunar Orbiter I, Pioneer VI and VII, and Mariner IV missions as well as for the ninth in a series of Atlas Centaur second stage booster tests are briefly described. R.N.A.

N67-15925*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARINER VENUS 67 PROJECT: GROUND INSTRUMENTATION FOR OCCULTATION
G. Levy *In its* Space Programs Sum. No. 37-42, Vol. III 30 Nov. 1966 p 90–92 (See N67-15901 06-07) CFSTI: HC $3.00/MF $0.65

The ground instrumentation for the Mariner Venus 1967 project occultation measurements is briefly described. The prime station for the occultation measurements will be the Deep Space Station 14 210-ft advanced antenna system. The Deep Space Station 14 occultation configuration, consisting of three receivers, is schematically shown and discussed. R.N.A.

N67-15926*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
VENUS DSS OPERATIONS
M. A. Gregg, E. B. Jackson, and A. L. Price *In its* Space Programs Sum. No. 37-42, Vol. III 30 Nov. 1966 p 92–95 (See N67-15901 06-07) CFSTI: HC $3.00/MF $0.65

Experimental activities at the Venus Deep Space Station are briefly discussed. They include bistatic planetary radar experiments, radio source evaluation, and reception from and transmission to the Mariner spacecraft. The performance and improvements of the station's transmitters, antennas, and receiving systems are also summarized. R.N.A.

N67-15928*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DSIF STATION CONTROL AND DATA EQUIPMENT
R. Flanders, G. Jenkins, A. Burke, W. Frey, and H. Baugh *In its* Space Programs Sum. No. 37–42, Vol. III 30 Nov. 1966 p 96–98 (See N67-15901 06-07) CFSTI: HC $3.00/MF $0.65

The status of the Deep Space Instrumentation Facility station control and data equipment is described. The equipment consists of an antenna pointing subsystem, digital instrumentation subsystem, station control and monitor console, telemetry and command processor, and frequency and timing subsystem. The functional objective of the equipment is to provide the capability for processing spacecraft telemetry and command data in direct mission support; to perform station monitoring, time tag data, supply reference frequencies, and to perform antenna pointing as mission independent support. R.N.A.

N67-15929*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
CONFERENCE NETS OF THE OPERATIONAL VOICE COMMUNICATIONS SUBSYSTEMS
F. E. Bond, Jr. and J. W. Capps *In its* Space Programs Sum. No. 37–42, Vol. III 30 Nov. 0966 p 98–102 (See N67-15901 06-07) CFSTI: HC $3.00/MF $0.65

An overall description is given of the management, configuration, and control of the operational voice communications subsystem which is a communications capability of the Space Flight Operations Facility fulfilling the requirement of end terminations and internal distribution of audio intelligence. The subsystem provides touch-tone signaling telephones, voice conference nets for talk-listen headsets/and sets and speakers, and point-to-point intercommunications. A tabulation of the current operational voice communications subsystem is provided and updated for all net custodians. R.N.A.

N67-15979# Army Electronics Labs., Fort Monmouth, N. J.
DUPLEXER FOR A RADAR SYSTEM USING A DUAL-MODE TRANSMITTER TUBE
William H. Wright, Jr. Sep. 1966 17 p ref
(ECOM-2765; AD-641981) CFSTI: HC $3.00/MF $0.65

The unique problems of the design of the duplexer for a radar system are discussed using a microwave triode oscillator to perform both the transmitter and local oscillator functions of a radar with the same tube. A novel duplexer design approach is proposed, which will result in effective duplexer performance in a small, reliable, and inexpensive package. Author (TAB)

N67-16004*# National Academy of Sciences—National Research Council, Washington, D. C.
RADIO PROPAGATION IN NON-IONIZED MEDIA
In its Progr. in Sci. Radio 1966 p 95–137 (See N67-16001 06-34) CFSTI: HC $3.00/MF $0.65

Studies on Radio propagation in non-ionized media centered on: (1) *Experimental Analysis of the Atmosphere*—refractometry of the troposphere, and radar angles in the clear atmosphere; (2) *Models of the Atmosphere*—fine atmosphere structure, and turbulence in the troposphere; (3) *Theoretical and Experimental Investigation of Propagation in Nonionized Media*—influence of surface irregularities on the propagation and reflection of radio waves, and path antenna gain in troposphere propagation; (4) *Effects of Propagation on the Measurements of Distance, Angle-of-Arrival, and Doppler Effect*—propagation effects in ground-to-ground systems, and earth-space links; (5) *Propagation and Radiometry for Millimeter and Submillimeter Wavelengths*—techniques and uses of infrared radiation, and millimeter wave radiometry; and (6) *Planetary Radio and Radar Astronomical Observations*—radar astronomical studies of planets. G.G.

N67-16040# Syracuse Univ. Research Corp., N. Y. Electronics Research Lab.
CALIBRATOR—SINGLE SIDEBAND ADAPTOR
L. J. Paciorek and C. D. Rasmussen Jul. 1966 59 p
(Contract Nonr-5020(00))
AD-641020) CFSTI: HC $3.00/MF $0.65

The report discusses a one year effort concerned with providing the Zenith ZX-5 and other HF band receivers with a Single Sideband(SSB) reception capability. Contained is information concerning design, development, evaluation and construction of thirty (30) model E-130, Calibration - SSB Adaptors provided for this purpose. All associated electrical and mechanical drawings and a complete E-130 Operating and Maintenance Manual are also included. In the SSB mode the E-130 adaptor produces a carrier (1.6 - 25 MHz) that can be injected into the receivers antenna terminal along with the sideband signal thus providing a means of demodulating SSB signals. Also provided in the small (48 cubic inches) battery operated adaptor is a 500 KkHz crystal oscillator and harmonic generator providing crystal harmonics for receiver dial calibration from 1 to 25 MHz. Both adaptor functions can be utilized without receiver modification. Author (TAB)

N67-16072# Ballistic Research Labs., Aberdeen Proving Ground, Md.
A RADIO FREQUENCY SECTION FOR A THREE-FREQUENCY DISPERSIVE DOPPLER RECEIVER
Harold Raub Jun. 1966 70 p ref
(BRL-MR-1756; AD-640862) CFSTI: HC $3.00/MF $0.65

The radio frequency (RF) portion of a radio receiver system designed, developed and constructed for use in upper atmosphere research is discussed. This receiver system, which is a double-super-heterodyne type, is used to supply data relative to dispersive Doppler, spin and Faraday rotation, and propagation attenuation. The function of the RF section, design criteria, approaches to the design, problems, and techniques used in overcoming the problems are discussed in detail. Author

N67-16079# Advanced Technology Corp., Timonium, Md.
STUDY OF ADAPTIVE ANTENNA TECHNIQUES FOR MILLIMETER WAVE APPLICATIONS Final Report, 15 Apr. 1965–15 Jul. 1966
J. M. Cotton, Jr. 15 Aug. 1966 142 p refs
(Contract AF 19(628)-5099)
(AFCRL-66-724; AD-641710) CFSTI: HC $3.00/MF $0.65

The study program was concerned with adaptive antenna techniques which could be utilized in the 35 - 100 GHz frequency range. Included are a survey of combining methods in general; discussion of the atmospheric limitations at millimeter wavelengths including an analysis of atmospheric dispersion; a discussion of the

techniques peculiar to millimeter wavelengths; and a recommended state of the art combining system using available components. Also included are recommendations for laboratory feasibility models, a millimeter wave interferometer system for atmospheric measurements and suggested development programs for components which would improve the potential and operating characteristics of the system. Throughout the study, emphasis was placed on very broad (i.e., 1 GHz or greater) bandwidth capabilities. Author (TAB)

N67-16080# Parke Mathematical Labs., Inc., Carlisle, Mass.
A STUDY OF ERROR-CORRECTING CODES: I Scientific Report
Lorenzo Calabi and Lester K. Arquette Aug. 1966 35 p refs
(Contract AF 19(628)-3826)
(SR-8; AFCRL-66-627; AD-640984) CFSTI: HC $3.00/MF $0.65

A formal study is made of the following properties of error-correcting codes: irredundance, precorrecting, and correcting. Author (TAB)

N67-16085# Electro Technical Analysis Corp., Tucson, Ariz.
FREQUENCY ASSIGNMENT STUDIES Interim Final Report, 1 May–31 Jul. 1966
A. J. Hoehn and T. W. McCurnin Ft. Monmouth, N. J., Army Electron. Command, Sep. 1966 202 p refs
(Contract DA-28-043-AMC-01232(E))
(ECOM-01232-IF; AD-641431) CFSTI: HC $3.00/MF $0.65

This is a report on a study to improve electromagnetic compatibility in the field army through development of frequency-assignment practices. Detailed instruction is given in the fundamentals and use of the synthesis method of frequency assignment. Comparisons are made with the present ABM plan. Simplified templates for the determination of far-site assignment exclusions are presented. Assignment of frequencies to radio-relay and radio-net systems is illustrated in detail. In the theoretical sections previous work is expanded and consolidated where necessary to present a complete account of the years work. The general frequency-assignment problem is defined in terms of exclusions imposed by the physical nature of equipments and geographic locations. The problem is formalized through use of mathematical set theory, and solutions discussed. The basis for design of frequency groups which automatically satisfy the set theory expressions is established. Methods for replication of assignments and the combination of the replication scheme with the frequency-group method are covered. Optimization methods, and problems arising from intermodulation and adjacent-channel interference are considered. TAB

N67-16098# Radio Corp. of America, New York. Advanced Communications Lab.
AN FDM–FM FEEDBACK DEMODULATOR FOR TROPO AND SATELLITE RELAY COMMUNICATIONS
F. Lefrak, H. Moore, and A. Newton [1966] 44 p refs Presented at the U.S. Seminar on Satellite Commun. Earth Sta. Technol., Washington, D. C., 16–27 May 1966

An FM feedback (FMFB) demodulator was developed for 120- and 240-channel FDM. The implementation is entirely solid state, including a 4.4-GHz VCO. For a specified deviation ratio, a tradeoff between threshold and distortion exists in the selection of loop bandwidth relative to the signal, and in the choice of pre-emphasis. Correspondingly, given a demodulator there is an optimum deviation ratio which results in minimum total channel noise and highest noise-power ratio (NPR) for a specified input carrier-to-noise ratio (C/N). Two FMFB designs are described, for 120 and 240 channels. For the former, a top-channel threshold C/T (carrier power-to-noise temperature ratio) of −150.7 dBW/° K was measured for 2.1 MHz rms deviation with 4 dB pre-emphasis, and −151.2 dBW/° K without pre-emphasis. For the 240-channel design threshold C/T with and without pre-emphasis is −148.9 and −149.0 dBW/° K respectively, with 2.7 MHz rms deviation. Asymptotic NPR values at high C/T range from 43.5 to 57 dB over the baseband with pre-emphasis, and from 45.5 to 49.5 dB without pre-emphasis. Author

N67-16123# System Development Corp., Santa Monica, Calif.
A LOW COST COMMUNICATION SATELLITE EDUCATIONAL SYSTEM
Irving Dlugatch 15 Aug. 1966 6 p Presented at 17th Intern. Astronautical Congr., Madrid, Oct. 1966
(SP-2493; AD-640649) CFSTI: HC $3.00/MF $0.65

The report discusses the potential of satellites for education and applies the principles of system engineering to studies of system implementation and cost effectiveness. The proposed system makes use of television and of a space vehicle, and excels by the modesty of its transmitter and receiver requirements on the ground and on the spacecraft. TAB

N67-16133# Lockheed Missiles and Space Co., Sunnyvale, Calif.
THE METHOD OF SPHERICAL REPRESENTATION FOR TREATING ELECTROMAGNETIC SCATTERING Final Scientific Report, 15 Apr. 1965–14 Apr. 1966
W. H. Watson 14 Apr. 1966 69 p refs
(Contract AF 19(628)-5094)
(LMSC-M-97-66-1; AFCRL-66-91; AD-641100) CFSTI: HC $3.00/MF $0.65

Since the distant scattered radiation is best represented as spherical waves, and generalized spherical functions may be used to establish a system of components for field vectors, each of which transforms independently on rotation, a spherical representation can be achieved with a geometry in which the surface of the scatterer is transformed into a sphere. At large distances, this geometry is chosen congruent with that of ordinary space. The generalized spherical functions are then taken to be functions of the angles in the spherical polar coordinate system in the transformed space, whose metric is non-Euclidean. Relevant properties of generalized spherical functions and means for computing them are described, and also the recurrence relations, derived from group theory, used to compute coupling integrals. The representation of spherical waves by generalized spherical functions, the transformation of Maxwells equations, and the representation of an arbitrarily polarized electromagnetic wave arbitrarily directed with respect to the polar axis of the spherical representation is developed. Geometrical and electromagnetic representation for an axially symmetric scatterer is treated in detail, and the derivation of coordinate systems from electrostatic field distributions is presented as a general method. The procedure for finding the scattered field, backscattering cross section, and radar scattering matrix for a perfectly conducting prolate spheroid is elaborated. Scattering by limiting prolate and oblate spheroids is discussed with advantage in terms of the spherical representation. Author (TAB)

N67-16141# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
LINE SCAN TELEVISION FOR EARTH OBSERVATION SATELLITES
C. J. Swet Sep. 1966 31 p refs
(Contract NOw-62-0604-c)
(TG-853; AD-641501) CFSTI: HC $3.00/MF $0.65

Studies indicate that line-scan television in the visible spectrum offers numberous advantages over conventional snap-shot techniques for observing the Earth from a satellite. These studies include the investigation of several camera design concepts, one which is described here to illustrate the current state of the art. They also included a parametric examination, summarized here, of coverage and other measures of system effectiveness for a postulated mission. Author (TAB)

N67-16148# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.

A THEORETICAL STUDY OF DIELECTRIC-COATED CYLINDRICAL ANTENNAS

Chung-yu Ting Jul. 1966 87 p *refs*

(Contract Nonr-1866(32))

(TR-506; AD-640665) CFSTI: HC $3.00/MF $0.65

A cylindrical antenna, either infinite or finite, which is imbedded in a concentric dielectric rod has been investigated by employing a rigorous formulation. The infinite case is solved easily by a Fourier transform method; the finite case is solved first by a numerical method, then by a two-term approximation. The mathematical analysis is intricate, nevertheless, the results obtained for the finite antenna are as simple as for the free-space dipole. It is shown in both cases that the input conductances are larger than for the corresponding free-space antennas, and the field patterns tend to be more broadside. The method is applicable regardless of the thicknesses of the antennas and the dielectric rod. This study is limited to thin antennas in rather thick dielectric cylinders. However, the dielectric rod is still not thick enough to support a T. M. mode. Author (TAB)

N67-16185# Harvard Univ., Cambridge, Mass. Cruft Lab.

THE INTEGRAL EQUATION FOR THE CURRENT IN AN ASYMMETRICALLY DRIVEN, THICK TUBULAR ANTENNA

S. R. Seshadri and Tai Tsun Wu Jun. 1966 24 p *refs*

(Contract Nonr-1866(32))

(TR-503; AD-641362) CFSTI: HC $3.00/MF $0.65

The coupled integral equations for the tranverse and axial currents in an electrically thick tubular antenna are derived for the case in which it is driven along an infinitesimally narrow circumferential gap by emf which is allowed to vary along the circumference. The emf is assumed to be maintained either on the outside surface only, or on the inside surface only, or on both the surfaces of the tube, as in the conventional treatments of antenna theory. For the special case of a driving emf which is uniform around the circumference, the transverse currents are not excited and the integral equation for the total axial current is shown to reduce to the known results both for the case in which the emf is maintained on both the outside and the inside surfaces of the tube and for which it is on the outside surface only.

Author (TAB)

N67-16189# Air Force Cambridge Research Labs., Bedford, Mass. Optical Physics Lab.

OPTICAL PULSE-RANGING WITH THE NANOLITE

Heinz Fischer Sep. 1966 10 p *refs* *Its* Instrumentation Papers No. 116

(AFCRL-66-653; AD-642426) CFSTI: HC $3.00/MF $0.65

Short-distance ranging of small-size targets by means of a noncoherent Nanolite spark source demonstrates accuracies within a few centimeters at ranges from 10 to 100 m. Several small-size targets can be distinguished within the same scope trace. The source, its operation, and power supply are simple. The device is extremely lightweight. Short-burst repetition rates of approximately 10,000 pps are possible. Author (TAB)

N67-16196# Naval Air Development Center, Johnsville, Pa. Aero Mechanics Dept.

INVESTIGATION OF THE INTERFACE BETWEEN THE AN/APX-64 (V) TRANSPONDS SET (MODE C) AND ENCODERS USED FOR ALTITUDE REPORTING Final Report

John P. McHale 10 Oct. 1966 21 p *ref*

(NADC-AM-6654; AD-640837) CFSTI: HC $3.00/MF $0.65

The report presents the results of a laboratory investigation of the interface between an AN/APX-64(V) Transponder Set and encoders employed for automatic altitude reporting. Author (TAB)

N67-16197# Lincoln Lab., Mass. Inst. of Tech., Lexington.

HAYSTACK DISPLAY TRANSLATOR

Stephen B. Russell 10 Oct. 1966 22 p *ref*

(Contract AF 19(628)-5167)

(ESD-TR-66-453; TN-1966-24; AD-640914) CFSTI: HC $3.00/MF $0.65

The Haystack Display Translator provides decimal displays of the Haystack antenna azimuth and elevation position angles, command azimuth and elevation angles, azimuth and elevation bias angles, or alternately, azimuth and elevation center of scan angles, and EST and GMT displays. Each of the 19-bit binary angle inputs is multiplied by a scale factor, converted from binary to BCD, and stored for display. EST in BCD is stored for display and also converted to GMT and stored for display. Author (TAB)

N67-16207# Syracuse Univ., N. Y.

MATRIX METHODS FOR SOLVING FIELD PROBLEMS. VOLUME II: COMPUTATIONS FOR LINEAR WIRE ANTENNAS AND SCATTERERS Final Report, Mar. 1965–Mar. 1966

Roger F. Harrington and Joseph Mautz Griffiss AFB, N. Y., RADC. Aug. 1966 166 p *refs*

(Contract AF 30(602)-3724)

(RADC-TR-66-351, Vol. II; AD-639745) CFSTI: HC $3.00/MF $0.65

The report gives general computer programs and tables of computations for linear wire antennas and scatterers with arbitrary excitations and loads. The parameters calculated include the input impedance of wire antennas with sources at arbitrary points along the wire, input impedance of loaded wire antennas, mutual admittance between collinear antennas, monostatic and bistatic scattering from linear wires both loaded and unloaded, and general admittance parameters for loaded wire scatterers. The computations are for wires of length-to-diameter ratios ranging from 10 to 2000, and for length-to-wavelength ratios from 0.05 to 2.10 in increments of 0.05. Author (TAB)

N67-16208# White Sands Missile Range, N. Mex. Range Instrumentation Systems Office.

ORBITAL PARAMETERS. PART I: INCLINATION AND NODAL CROSSING OF THE ORBITAL PLANE FROM RADAR DATA

P. J. Short and W. L. Shepherd Jan. 1966 22 p *refs*

(RISO-1-66; AD-640965) CFSTI: HC $3.00/MF $0.65

The study utilizes a well-known theorem concerning minima for a certain class of quadratic forms of three variables with a normalizing constraint to determine the angle of inclination and the right ascension of nodal crossing of the orbital plane of a near earth satellite from observation data. Author (TAB)

N67-16212# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.

A COMPARISON OF THREE METHODS FOR THE CORRECTION OF RADAR ELEVATION ANGLE REFRACTION ERRORS

B. D. Hinds and R. G. Pappas Aug. 1966 31 p *refs*

(ECOM-5071; AD-641705) CFSTI: HC $3.00/MF $0.65

The atmospheric effects on microwave radiation were investigated by using a ground based radar and a fixed beacon combination at White Sands Missile Range, New Mexico. With this radar-beacon combination, the approximate range and elevation angle between the two sites were 45 miles and 1 degree respectively. This investigation compares three methods for correcting the radar elevation angle error caused by the atmosphere. One method uses the measured meteorological parameters sampled by radiosonde instruments while the second and third methods utilize an exponential vertical structure fixed by a measured surface refractive index value. Author (TAB)

N67-16335# Ohio State Univ. Research Foundation, Columbus. Dept. of Electrical Engineering.

A FIRST ORDER APPROACH TO RADOME BORESIGHT ANALYSIS AND DESIGN

R. E. Van Doeren 15 Mar. 1966 41 p refs

(Contract NOW-64-0293-d)

(Rept.-1804-6; AD-641197) CFSTI: HC $3.00/MF $0.65

A simplified first-order theory of radome boresight error is derived and applied to prediction and design problems. Reasonable predictive results are obtained for radomes with known boresight error. The dependence of boresight error on the derivatives of IPD and absolute value of T with respect to incidence angle is shown and the significance of polarization in light of the theory is discussed. Polarization control is shown to reduce boresight error when used with an appropriate radome wall design. The possibility of a cancellation design for a radome, wherein the errors due to phase tapering and to differential attenuation tend to cancel each other is pointed out. The concept of artificially introduced loss to achieve such cancellation is discussed. A design example is included. Radome design curves giving absolute value of T squared, IPD, d/d theta(IPD), and d/d theta absolute value of T for several important radome wall structures are also included. Author (TAB)

N67-16336# Stanford Univ., Calif. Dept. of Statistics.

PREDICTION OF A NOISE-DISTORTED, MULTIVARIATE, NON-STATIONARY SIGNAL

Eugene Sobel 31 Oct. 1966 22 p refs

(Grant DA-ARO(D)-31-124-G726)

(TR-19; AROD-2025-19; AD-642727) CFSTI: HC $3.00/MF $0.65

The paper represents a generalization of one of the main theoretical results of my Ph.D. thesis. The work is an outgrowth of work first begun by E. J. Hannan and a correct conjecture by P. Whittle. The main theorem of this paper proves the existence of, and gives an explicit formula for, the asymptotic best linear predictor of a certain type of non-stationary multivariate time series from noise distorted observations. The non-stationarity arises from the fact that the signal satisfies a difference equation, which when considered as a polynomial, has only elementary divisors. The proof is accomplished by showing, through Hilbert space and harmonic analysis methods, that the generating function is a limit of the generating functions of the stationary analogue; that is, where the difference function has elementary divisors. Finally, it is shown that this asymptotic generating function exactly predicts null solutions to the difference equation. The proof is direct and due to E. J. Hannan. TAB

N67-16349# Harry Diamond Labs., Washington, D. C.

A FLUSH-MOUNTED COMPOSITE RADOME ANTENNA SYSTEM

Howard S. Jones, Jr. Aug. 1966 31 p refs

(HDL-TR-1327; AD-641012) CFSTI: HC $3.00/MF $0.65

An integrated radome-antenna structure for use on aircraft, space vehicles, or guided missiles is described. The design principle employed fully utilizes the dielectric material from which the radome is fabricated. The elemental antenna is a slotted array, designed from metallic-plated dielectric-loaded waveguide, which is an integral part of the radome. The antenna array of the system has a one-way gain of approximately 8 db, 20 db side lobe suppression, and a voltage standing wave ratio of less than 1.5 measured over a 10 percent bandwidth. Theoretical considerations, design techniques, and material characteristics are discussed. Also included are electrical performance characteristics and illustrations of a complete radome-antenna system. The antennas occupy practically no additional volume in the structure and can be designed to give very good performance in several frequency bands. Author (TAB)

N67-16406# Rome Air Development Center, Griffiss AFB, N. Y. Research and Technology Div.

WIDEBAND ARRAY ANTENNA USING I-F TIME DELAY STEERING Final Report

John B. Payne, III Oct. 1966 24 p refs

(RADC-TR-66-289; AD-642773) CFSTI: HC $3.00/MF $0.65

If time delay steering of a wideband array antenna is introduced at the i-f frequency instead of at the r-f level, all of the element signal phases will be different and the summed pulses will not add in-phase to produce a beam in the desired direction. It is found that when i-f delay steering is used, an additional incremental phase shift must be introduced into the local oscillator of each mixer to produce in-phase summation. The delay provides alignment of the envelopes while the local oscillator phase shift provides in-phase summation. This condition is found to be independent of frequency and thus bandwidth. The effect of i-f delay error on the systems response is discussed. Author (TAB)

N67-16410# Army Test and Evaluation Command, White Sands Missile Range, N. Mex.

EFFECTS OF GEODETIC MEASUREMENT ERRORS ON TRAJECTORY DATA Final Report

Robert E. Green Jun. 1966 27 p refs

(RE-S-66-1; AD-640964) CFSTI: HC $3.00/MF $0.65

The report presents the contribution of geodetic measurement errors to the measurement of vehicle position and velocity by trilateration and triangulation methods. Mathematical expressions are derived that describe the propagation of survey measurement errors through coordinate transformations. A numerical example of the error in trilaterative position and velocity determination, resulting from uncertainty in the location of the measuring instrument, is included. Author (TAB)

N67-16428# Michigan Univ., Ann Arbor. Communication Sciences Lab.

SOME THEORETICAL AND EXPERIMENTAL ASPECTS OF ANALYSIS WITH THE SOUND SPECTROGRAPH

Hugh K. Dunn, Tiong Suy Yu, and William D. Chapman Aug. 1966 218 p refs

(Contract Nonr-1224(22))

(Rept.-7; AD-642058) CFSTI: HC $3.00/MF $0.65

Before the introduction of the sound spectrograph in 1946, analysis of complex audio phenomena, such as speech, into time, frequency, and amplitude coordinates depended for the most part on a very time-consuming Fourier analysis of an oscillographic record of the event. The techniques introduced with the sound spectrograph permitted the speeding-up of the analysis procedure by a large factor. These techniques and their underlying principles are discussed. The use of a bank of filters to accomplish real-time speech analysis is not discussed, but that form of the sound spectrograph which achieves frequency analysis by sweeping the spectrum of the recorded signal past a single analyzing filter is discussed in detail. A sound spectrograph developed at the Communication Sciences Laboratory of the University of Michigan is then described, and samples of work with the machine are shown. This instrument includes some novel features, such as the automatic marking on the spectrogram of time, frequency, and amplitude scales. Author (TAB)

N67-16449# Institute for Defense Analyses, Washington, D. C. Research and Engineering Support Div.

RESOLUTION OF MULTIPLE TARGETS IN CLUTTER

Donald Richman Jun. 1966 87 p refs

(Contract ARPA SD-50)

(IDA/HQ-66-5086; P-158; AD-641430) CFSTI: HC $3.00/MF $0.65

The paper deals with the problem of waveform design for multiple target resolution. The objective of the paper is not to

offer solutions but to illuminate boundaries of validity of present concepts and indicate areas where basic analytical tools--potentially available and necessary--do not exist as yet. Author (TAB)

N67-16467# Sylvania Electric Products, Inc., Waltham, Mass. Applied Research Lab.

IMPEDANCE OF FINITE INSULATED CYLINDRICAL ANTENNA IN A COLD PLASMA WITH A LONGITUDINAL MAGNETIC FIELD

J. Galejs 25 Jul. 1966 40 p refs
(Contract AF 19(628)-5718)
(SR-2; AFCRL-66-551; AD-640063) CFSTI: HC $3.00/MF $0.65

A variational formulation is developed for the impedance of a finite cylindrical antenna embedded in a dielectric cylinder, which is surrounded by a magnetoionic medium (cold electron plasma) with the static magnetic field impressed in a direction parallel to the antenna axis. Closed form expressions are obtained in the limit of low frequencies, and for short antennas in a uniaxial medium. The impedance of a short antenna is nearly the same as for an assumed triangular current distribution, except that further resonances are observed in the vicinity of the gyro frequency, where the antenna becomes electrically long. These resonances may be shifted to frequencies exceeding the gyro frequency in the presence of an insulating layer around the antenna. For very thin insulating layers the wave number of the variationally approximated current distribution is to the first order equal to square root of epsilon sub 1 k sub o(e sub 1 epsilon is the leading diagonal element of the permittivity matrix), where the gyro frequency may be both smaller or larger than the plasma frequency. However this approximation does not apply to current distributions along the insulated antenna. The present calculations are also compared with earlier work on antenna impedances. Author (TAB)

N67-16485# Sichak Associates, Nutley, N. J.

TELEMETRY TAPE COMBINER SYSTEM Final Report, Oct. 1962–May 1966

Berl W. Martin et al Patrick AFB, Fla., Telemetry Branch, Jun. 1966 207 p ref
(Contract AF 08(606)-5739)
(ETR-TR-66-5; AD-640447) CFSTI: HC $3.00/MF $0.65

The report covers the study, investigation and experimentation performed in Phases I and II of the Telemetry Tape Combiner program. The objective of the contract (Phases I and II) was a breadboard demonstration of suitable techniques for optimally combining several telemetry tape recordings into one. The important problem areas in the development had to do with slaving together the separately recorded wideband signals with sufficient accuracy and speed of response to maintain coherent addition despite rapidly fluctuating errors in relative timing. Most of the effort in Phase I was devoted to the fundamental problem of time delay correction. Four different solutions (2 digital, 2 analog) were investigated and compared, with preference being given to a system of binary switching of fixed delay lines for further development in Phase II. A portable tape recorder test set was developed and used to obtain experimental values of time delay errors introduced by typical tape machines at the Air Force Eastern Test Range. For Phase II an 800 microsecond 1.5 mc bandwidth variable delay line was constructed and two-reproducer predetection tape combiner breadboard was assembled. The delay line range, speed of response and bandwidth were adequate. The delay line initially used an amplitude modulated carrier and excessive transient noise was produced. When the delay line was rebuilt using an FM carrier system satisfactory performance was achieved. Various test signals were successfully combined. A recommended plan for an operational combiner is presented. Author (TAB)

N67-16489# Army Electronics Labs., Fort Monmouth, N. J.

DESIGN OF INTEGRATED ELECTRONIC DELAY LINE FOR A MAN-TRANSPORTABLE MTI RADAR SET

George A. Hrivnak Sep. 1966 23 p
(ECOM-2759; AD-641328) CFSTI: HC $3.00/MF $0.65

Range gating is a process of quantizing range (time) into small intervals in Moving Target Indication Radar sets. The principal purpose of range gating is to eliminate the so-called collapsing loss effect that is inherent to delay line canceler filters. In range gating, each range gate opens in sequence just long enough to sample the video waveform corresponding to a different range interval in space. Since noise from other time intervals is excluded the collapsing loss does not take place. This report deals with the design of an electronic delay line which generates the sequential gating pulses for range-gate filters. Author (TAB)

N67-16497# Lincoln Lab., Mass. Inst. of Tech., Lexington.

HAYSTACK POINTING SYSTEM: SCAN

William R. Crowther 1 Nov. 1966 44 p
(Contract AF 19(628)-5167)
(ESD-TR-66-565; TN-1966-55; AD-643171) CFSTI: HC $3.00/MF $0.65

As one of its options, the Haystack pointing system can superpose a scan on any other pointing task. The available scans include both simple one-dimensional scans and area-covering scans. Author (TAB)

N67-16500# Naval Scientific Technical Information Center, London (England).

SURFACE ROUGHNESS AND EFFECTIVE REFLECTION COEFFICIENT OF THE SEA IN 9GC BAND WAVE PROPAGATION

Takeski Marukawa Jun. 1966 14 p refs Transl. into ENGLISH from Denki Tsushin Gakki Zasshi (Japan), v. 45, no. 8, 1962 p 1071–1075
(NSTIC/07072/66; TT-66-62469; AD-640519) CFSTI: HC $3.00/MF $0.65

The most important factor among the radio wave propagation path constants with regard to micro-waves whose path lies across the surface of the sea is the value of the effective reflection coefficient rho sub e. In the present survey propagation experiments were carried out with a 9Gc band on real sea surfaces at a distance of 3.52 Km respectively from the transmitter. Three experiments were carried out, two in winter (November, 1959 and February-March, 1961) and one in summer (August, 1959). Measurements of rho sub e by means of the antenna height pattern method, and of the size of the waves at the reflection points were carried out simultaneously. The waves were shown in wave height values, and a hydraulic gauge was employed. As a result of the experiment it became clear that the rho sub e value of the surface of the sea and its short-term variation distribution bear a close relationship to the size of the waves and the motion thereof. Thus, (1) the rho sub e value decreases rather as the size of the waves increases, (2) the variation in rho sub e increases as the waves increase, (3) as a result of the sea waves extremely short fading cycles occur. Appended is some research on determining rho sub e for a rough surface in motion such as the sea, and on the method of measuring rho sub e. Author (TAB)

N67-16555*# National Aeronautics and Space Administration, Washington, D. C.

SPACE TECHNOLOGY, VOLUME V: TELECOMMUNICATIONS

J. J. Stiffler (JPL) 1966 148 p refs
(NASA-SP-69) GPO: HC $0.55; CFSTI: MF $0.65 CSCL 17B

Techniques for improving components and data handling and modulation systems in telecommunication are discussed. The mathematical fundamentals are summarized, and component designs for increased signal power at the receiver are described. Details

are presented on analog modulation and recent pulse modulation techniques, and the advantages inherent in pulse modulation are indicated. Data compression with the pulsed modulation is covered, and the spacecraft tracking problems of ranging and telemetry synchronization are discussed. The telemetry systems actually used in the Pioneer and Mariner programs are reveiwed, including the ground based equipment at the Deep Space Instrumentation Facilities at the transmitting–receiving sites of Goldstone, California; Woomera, Australia; and Johannesburg, South Africa. N.E.N.

N67-16560*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
NONLINEAR CHARACTERISTICS OF PULSE-DURATION MODULATION
C. S. Lorens 15 Feb. 1967 13 p refs
(Contract NAS7-100)
(NASA-CR-81296; JPL-TR-32-1069) CFSTI: HC $3.00/MF $0.65 CSCL 09D

A comparison of pulse-duration demodulation with pulse-code demodulation indicates that there is a pulse-code modulation (PCM) system that will outperform any pulse-duration modulation (PDM) system by about 2-1/2 dB input power at 20 dB output signal-to-noise ratio, 4-1/2 dB at 30 dB, and 7 dB at 40 dB. However, the PDM systems outperform the PCM systems at a sufficiently high input signal-to-noise density ratio. Pulse-duration modulation thus tends to make better use of high signal strengths, while pulse-code modulation makes better use of low signal strengths. Author

N67-16573*# TRW Systems, Redondo Beach, Calif.
INFLUENCE OF DATA TYPE AND RATE ON SHORT ARC LUNAR ORBIT DETERMINATION
D. J. Johnson and E. A. Emerson [1966] 48 p refs
(Contract NAS1-4605-7)
(NASA-CR-66245) CFSTI: HC $3.00/MF $0.65 CSCL 09F

This task provides an error analysis, a presentation of its findings, and a method which enables one to select optimum rates for taking counted Doppler rate data and range data for a particular short arc of tracking a lunar satellite from the earth. The user of these results must have available the following information for the data taking instruments (of the DSN) and for the computation of residuals in the ODP-L: 1) the relationship between counted Doppler standard deviations (including all instrument, correlation, and software effects) and the Doppler count interval, and 2) the effective range residual standard deviation, presently estimated to be 15 meters. The approximations and assumptions which were made to obtain the error analysis on TRW software are straightforward and are fully discussed. The measure used for the error is thoroughly explained. Results are presented in tables and in contour plots for use as working tools. Author

N67-16574*# TRW Systems, Redondo Beach, Calif.
REVIEW OF A DSIF DATA TAKING AND ORBIT DETERMINATION METHOD
R. D. Elliot [1966] 37 p refs
(Contract NAS1-4605-7)
(NASA-CR-66246) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Some of the characteristics of the Deep Space Instrumentation Facility (DSIF) as it applies to the determination of lunar orbits and the solution of lunar gravitational potential constants, is reviewed. The capability of the DSIF to determine orbital parameters and lunar potential constants can be analyzed in terms of the errors committed in the links of the data chain from sensor to the determinad orbital parameters. The results parallel those results reflected in accuracy estimates, and it is concluded that the DSIF should indeed have the capability required to perform lunar orbiting mission data gathering and analysis. The data used in this report were taken from reports on the Ranger VI and Ranger VII missions. Author

N67-16596# Rome Air Development Center, Griffiss AFB, N. Y.
SUPPORT TO DCA TROPOSPHERIC SCATTER TESTS Final Report, Oct.–Dec. 1965
Olindo A. Tagliaferri Oct. 1966 207 p refs
(RADC-TR-66-609; AD-640942) CFSTI: HC $3.00/MF $0.65

An experimental investigation was conducted in the Caribbean area to relate measured meteorological parameters with ground-to-ground radio signal characteristics. The ground-to-ground link was the 614 km. overwater path between Grand Turk, British West Indies, and East Island, Puerto Rico, using AN/MRC-98 Radio Sets. Meteorological measurements were made from sea level to an altitude of 17 km and covered the areas along the ground-to-ground propagation path, off-axis to this path, and in the vicinity of the ground stations. The airborne measurements were performed by four specially equipped METEOROLOGICAL and MARCOM (Microwave-Airborne-Relay Comm) aircraft. Ground measurements were performed in the vicinity of the troposcatter terminals by specially equipped meteorological poles. Author (TAB)

N67-16626* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
IMPLEMENTATION OF THE AIMP D AND E TELEMETRY ENCODING SYSTEM EMPLOYING MOSFETS
Donald C. Lokerson Jul. 1966 114 p refs
(NASA-TM-X-55652; X-711-66-340) CFSTI: HC $3.00 CSCL 09F

The increased complexity of small scientific spacecraft has spurred the development of more compact and complex telemetry encoding packages such as the A-IMP Encoder. The grouping of much of the on-board data processing within the encoder package has reduced the interconnection and interfacing problems within the spacecraft. The experimenter is relieved of the burden of design and fabrication of much of the electronics, but the use of integrated electronic circuits has become necessary. A recent technological advancement has made the use of many Metal Oxide Field Effect Transistors (MOSFETS) integrated on one chip a most advantageous type of building block for telemetry encoders. This paper will outline the various functions performed within the Anchored Interplanetary Monitoring Platform (A-IMP D&E) Telemetry Encoder and then explain in detail how the 4,300 MOSFET devices are employed within the four pound package. The test procedures used will also be outlined for each stage of the fabrication process. Author

N67-16627* Cubic Corp., San Diego, Calif.
ANTENNA CONFIGURATION FOR NASA–AMES LANDING SYSTEM
Peter C. Nelson Jun. 1966 107 p refs
(Contract NAS2-3681)
(NASA-CR-73063) CFSTI: HC $3.00 CSCL 09F

Described are tests and test results of several potential configurations. The NASA–Ames Landing System DME (Distance-Measuring Equipment) operates at 282 MHz, 273 MHz, and 282 MHz, and is a tone-type CW ranging system. The purpose of the tests is to investigate the effect of signal lobing for various antenna configurations operating at low elevation angles and to recommend a configuration which would minimize lobing effects on DME performance. A horizontally polarized directional antenna is recommanded. Author

N67-16634*# Harvard Univ., Cambridge, Mass. Gordon McKay Lab.
AN EXPERIMENTAL STUDY OF THE DIPOLE ANTENNA WITH NONREFLECTING RESISTIVE LOADING
Liang-Chi Shen Sep. 1966 65 p refs
(Grant NsG-579)
(NASA-CR-81331; SR-7) CFSTI: HC $3.00/MF $0.65 CSCL 09F

The amplitude of the current, the input admittance, and the radiation field pattern of a cylindrical antenna with a step-function internal impedance are measured in the frequency range 450 to 900 MHz. Several designs of the step-function are tried in order to simulate the antenna with the smoothly distributed resistive loading which has been studied in previous reports. The experimental result is compared with the theory. It has been found that the zero-order theory gives accurate descriptions of the current distribution, the field pattern, the property of a very broad frequency band of the antenna, and the existence of the traveling wave on the antenna. The agreement of the input admittance is not good, but it is found that the theoretical input admittance of the infinitely long resistive antenna which is obtained by a Fourier Transform method fits the experimental data satisfactorily. Author

N67-16668*# ADCOM, Inc., Cambridge, Mass.
ADVANCED THRESHOLD REDUCTION TECHNIQUES STUDY
Cesar A. Filippi Washington, NASA, Jan. 1967 140 p refs
(Contract NAS5-9011)
(NASA-CR-682) CFSTI: HC $3.00/MF $0.65 CSCL 09F

The threshold improvement capabilities of feedback and band-dividing demodulation techniques are investigated for PM or FM signals having a large index and/or deviation. The threshold performance of phase-locked and frequency-compressive feedback demodulators is analyzed and an optimum second-order phase-locked demodulator having a sinusoidal phase detector is developed and tested along with a conventional FM demodulator. Optimum higher-order loops are also derived as approximations to an optimum demodulator. Their threshold improvement capabilities are established and a third-order loop is developed and tested. The cycle slippage with a sawtooth phase detector is also investigated. Finally, several band-dividing systems based on either direct demodulation or signal estimation techniques are analyzed and compared to the phase-locked demodulator. Author

N67-16674*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
IMP D&E (AIMP) PFM ENCODING SYSTEM INTERFACE DOCUMENT
Donald C. Lokerson Aug. 1966 78 p ref Revision A
(NASA-TM-X-55653; X-711-66-384) CFSTI: HC $3.00/MF 0.65 CSCL 09D

The IMP's D&E encoding system is described. General and telemetry format and data processing information are given. The readout of the experiment digital words; analog data for the experiment; sync pulses supplied to the experimenter; and circuit design and fabrication techniques are discussed. Differences between IMP's D&E and IMP's A, B, & C are listed. Descriptions of each of the various interface experiments used with the IMP D&E system, are given. The digital data processor (DDP) incorporated into the encoding system is also described. L.S.

N67-16698*# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Electrical Engineering.
A SPACE COMMUNICATIONS STUDY Final Report, Sep. 15, 1965–Sep. 15, 1966
Kenneth K. Clarke, Raymond L. Pickholtz, and Donald L. Schilling 15 Sep. 1966 164 p
(Grant NGR-33-006-020)
(NASA-CR-81379) CFSTI: HC $3.00/MF $0.65 CSCL 09F

Consideration is given to the reception of frequency modulated signals passed through deterministic and random time-varying channels. Optimum receivers such as Bayes and maximum likelihood estimation were examined, as well as the suboptimum phase lock loop and FM discriminator. Emphasis was placed mainly on reception of digital data, although some novel techniques for processing analog and telemetry type information were investigated. Some computer studies were initiated to compare the behavior of optimal and suboptimal receiver structures. Theoretical research led to new receiver structures for the demodulation of digital and analog signals. S.P.

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N67-15355# Rome Air Development Center, Griffiss AFB, N. Y. Research and Technology Div.
INTERPROGRAM COMMUNICATIONS, PROGRAM STRING STRUCTURES, AND BUFFER FILES Final Report
E. Morenoff and J. B. McLean Oct. 1966 27 p refs
(RADC-TR-66-580; AD-640798) CFSTI: HC $3.00/MF $0.65

The basic features of Program String Structures are reviewed in the context of their employment in the generation and modernization of large programming systems. The principles of operation of the Buffer File, the fundamental element of the Program String Structure are described. The implications of the application of Buffer Files outside the framework of the Program String Structure are examined in terms of their unique characteristics. The Buffer File mode of operation provides a generic method for effecting both intra-computer and inter-computer program communication. It can be used for the passage of streams of data from one program to another, as well as for the passage of the more static program state type data. The Buffer File mode of operation may be used to synchronize the execution of otherwise asynchronously running programs and as a basic scheduling and resource allocation mechanism of the computer monitor system. Author (TAB)

N67-15383*# Purdue Univ., Lafayette, Ind. Jet Propulsion Center.
COMPUTER PROGRAMMING FOR A DIGITAL DATA ACQUISITION SYSTEM
Nicholas J. Barsic Aug. 1966 209 p refs
(Grant NsG-592)
(NASA-CR-81159; TM-66-7; JPC-426) CFSTI: HC $3.00/MF $0.65 CSCL 09B

A data acquisition system, composed of analog and digital subsystems, is described, including establishing a digital tape format, developing a method for obtaining records of experimental data in engineering units, and analyzing data by techniques familiar to engineers. Different digital tape coding formats were studied, and a format suitable for storing experimental data for easy accessibility was devised. Several computer programming languages were investigated, and Fortran and MAP languages were selected to perform all programming tasks. The manner in which the programs are written is described to aid in any future alteration. In order to obtain data in engineering units, a statistical analysis was performed on instrumentation measurements. Several curve fitting techniques were studied before selecting the ones discussed in this paper. Finally procedures were established for analyzing data and preparing the digital subsystem programmers to use the existing programs and alter them if necessary. Sample digital recording data obtained from rocket engine test firings are presented, including results and recommendations for future use of the data system. L.E.W.

N67-15391*# Radio Corp. of America, Princeton, N. J. RCA Labs.
LAMINATED FERRITE MEMORY, PHASE II Final Technical Report, Jun. 1, 1965–Jun. 30, 1966

R. L. Harvey, I. Gordon, and A. D. Robbi Aug. 1966 66 p refs
(Contract NASw-979)
(NASA-CR-81162) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Research conducted on thermally stable ferrite materials tailored to laminated memory arrays operated at low current levels is described. For this application a ferrite combining low coercive force, small grain size, high Curie temperature, and high resistivity is necessary. The manganese–ferrous ferrite, manganese–lithium ferrite, and manganese–magnesium ferrite systems (including, in some cases, small amounts of other metal ions) are studied. A manganese–magnesium–zinc ferrite (.10 ZnO-.27 MnO-.315 MgO-.315 Fe_2O_3) has the best combination of properties for laminated memory arrays. Arrays containing 256×100 conductors were successfully operated, without compensation, over a temperature range of 0° to 50°C. Author

N67-15758*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
INFORMATION PROCESSING: A CLASS OF TWO-WEIGHT CODES
R. J. McEliece *In its* Space Programs Sum. No. 37–41, Vol. IV 31 Oct. 1966 p 264–266 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

A general theory is presented which proves the existence of an infinite number of irreducible cyclic codes in which only two weights occur. These codes are shown to have essentially the same error-correcting abilities as single-weight primitive cyclic codes, and considerably larger rates. Theory applications are considered and a table of two-weight codes that have been constructed is shown. A.G.O.

N67-15759*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
INFORMATION PROCESSING: TRI-WEIGHT CYCLIC CODES
G. Solomon *In its* Space Programs Sum. No. 37–41, Vol. IV 31 Oct. 1966 p 266–268 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

The proof of a theorem is presented which characterizes a class of cyclic codes with three non-zero weights. The code words of different weights are characterized algebraically, and thus non-linear codes with specified weights can be encoded algebraically. These codes have low cross correlation values and are useful in spread-spectrum communication systems for multiplexing operations. A.G.O.

N67-15774 Library of Congress, Washington, D. C. Aerospace Technology Div.
COMPUTER TECHNOLOGY Surveys of Foreign Scientific and Technical Literature
Boris Doncov 29 Sep. 1966 85 p refs Compilation of Abstracts
(ATD-66-120)

This compilation of abstracts is based on Soviet open sources published 1964–1966. It is the seventh in a series of reports reviewing Soviet developments in computer technology. A bibliography is included. Information is included on: semiconductor-controlled memory unit with increased speed of operation; tape cores as logical elements for digital computers; a magnetic parametron-type null circuit; scanning device utilizing a fiber-optical converter; model for intermediate neuron; micromodule construction techniques; electron-optical memory; magnetic logic elements; logical organization of the VNIIEM-3 control computer; small-size digital computer; electronic digital computers at the "INFORGA-65" exhibit; information conversion device; simple failure indicator; decoding device; converters for telemetry systems using magnetic elements; and experimental device for coding and entry of electrical signals into a computer. Author

N67-15786*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE FEASIBILITY OF ACHIEVING OPTICAL DENSITIES IN MAGNETIC INFORMATION STORAGE
D. I. Tchernev *In its* Space Programs Sum. No. 37–40, Vol. 4 31 Aug. 1966 p 22–23 refs (See N67-15781 06-34) CFSTI: HC $3.00/MF $0.65

The Faraday effect in many magnetic materials is reviewed, and methods of making the film discontinuous are briefly discussed. The most promising method for high density magnetic writing is considered to be thermal writing, or Curie point writing; its advantages and disadvantages are assessed. Based on the preliminary research results, it is considered feasible to store magnetic information at densities of 10^8 bits/cm. M.G.J.

N67-15827*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DATA COMPRESSION: A LOWER BOUND FOR EPSILON ENTROPY
E. Posner and H. Rumsey, Jr. *In its* Space Programs Sum. No. 37–40, Vol. 4 31 Aug. 1966 p 225–228 ref (See N67-15781 06-34) CFSTI: HC $3.00/MF $0.65

A lower bound is given for the asymptotic behavior of the epsilon entropy of a Gaussian stochastic process on the unit interval under square error fidelity criterion. The lower bound is apparently weaker than the one previously obtained, but it is easier to work with. Author

N67-15828*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
INFORMATION PROCESSING: A BIVARIATE OF GOODNESS-OF-FIT TEST
T. Pitcher (Univ. of Southern Calif.) *In its* Space Programs Sum. No. 37–40 Vol. 4 31 Aug. 1966 p 228–230 ref (See N67-15781 06-34) CFSTI: HC $3.00/MF $0.65

Bivariate extreme value theory has been used to estimate error and erasure probabilities in Mariner-type command detectors. Since a bivariate distribution must fit with a bivariate extreme value distribution, a bivariate goodness-of-fit test is desirable. A new test for this purpose is derived. The test is similar to the Kolmogorov–Smirnov univariate test used in extreme value applications to single channel command systems. However the present test is not distribution free, since a transformation must first be performed which depends on the alleged distribution. The transformations are simple enough, however, to make the test useful in bivariate extreme value theory. R.N.A.

N67-15882*# Bellcomm, Inc., Washington, D. C.
FUNCTIONAL REQUIREMENTS FOR SPACEBORNE COMPUTERS ON ADVANCED MANNED MISSIONS
E. L. Gruman and P. S. Schaenman 24 Oct. 1966 17 p refs
(Contract NASw-417)
(NASA-CR-81237; TM-66-1031-2) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Functions which will require support from the on-board computer system are discussed. It is concluded that: (1) The functions (G&N, attitude control) which originally justified using on-board computers are no longer the pacing factors in determining many computer system characteristics. (2) Mission complexity will force the crew to make extensive use of computer system support. (3) The growth of computer usage in spaceborne scientific experimentation will parallel the historical surge evident in ground-based experimentation. (4) Increased functional requirements will result in a greatly increased number of I/O channels, increased high speed memory, the addition of off-line bulk storage, and more powerful processing capability, regardless of the specific system configuration. (5) The amount of on-board software required for a manned flyby mission will be large relative to manned missions heretofore. Author

N67-15905*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE JPL MATRIX OPERATIONS PROGRAMMING SYSTEM
P. M. Muller *In its* Space Programs Sum. No. 37–42, Vol. III 30 Nov. 1966 p 12–15 (See N67-15901 06-07) CFSTI: HC $3.00/MF $0.65

Described is an automatic Fortran IV programming system which accomplishes all matrix and vector operations plus a sophisticated input–output and housekeeping scheme. This system is programmed in Fortran IV in such a way that it should be readily convertible to any modern computing system with a Fortran IV compiler and at least 16,000 words of core. Discussed are advantages and cost, the system operators, system operations, automatic functions and controls, and system design features. Included are examples of matrix operations programming (MOP) system programs.
S.C.W.

N67-16076# Library of Congress, Washington, D. C. Aerospace Technology Div.
SOVIET COMPUTER RELIABILITY
Stuart G. Hibben *In its* Foreign Sci. Bull., vol. 2, no. 11 Nov. 1966 p 1–14 refs (See N67-16075 06-34)

Production, maintenance, and other factors are discussed in terms of their effect on three medium-capacity general-purpose Soviet computers: Ural-2, M-20, and Dnepr. The last is a solid state device. Despite regular maintenance programs, many faulty operations are reported; and critical design and maintenance procedures are detailed for the three computers. Main causes of failure along with times required to make the necessary repairs are included, and it is noted that the best computers can operate only a few hundred hours between failures. The most frequent complaint with regard to efficient computer operation is reported to be the lack of trained operating and maintenance personnel. Mention is also made of the low quality of Soviet magnetic tape, which cannot be stored for extended periods of time.
M.W.R.

N67-16124# RAND Corp., Santa Monica, Calif.
DEVELOPMENT OF DISCRETE DIGITAL SIMULATION LANGUAGES
Philip J. Kiviat 22 Sep. 1966 10 p refs Submitted for Publication
(P-3453; AD-640069) CFSTI: HC $3.00/MF $0.65

The article deals with a particular type of simulation: the use of numerical and logical models to represent discrete changes of state of a system as it moves through time. Simulation models of this type are usually formulated symbolically using flow charts or logic diagrams, coded in some programming language, and run on a digital computer. The report presents the history, current status and possible future of discrete digital simulation languages -- computer languages that are used for describing the structure and dynamics of discrete-time systems.
Author (TAB)

N67-16126# System Development Corp., Santa Monica, Calif.
COMPUTER SOFTWARE: DEVELOPMENTS AND RECENT TRENDS IN PROGRAMMING AND OPERATING SYSTEMS
Christopher J. Shaw 26 Aug. 1966 18 p Presented at EDP Comm. Sem. of the League of Calif. Cities, Santa Monica, Calif., 26 Aug. 1966
(SP-2582/000/00; AD-640655) CFSTI: HC $3.00/MF $0.65

The report briefly defines such concepts as: Computer software, programming and operating system functions, programming languages and processors, machine independence, procedurality, generality, interpreters, translators, assemblers, compilers, and generators. It discusses, in relatively non-technical terms, major developments in operating systems, and outlines the kind of interactive programming system that could shortly result from these trends.
Author (TAB)

N67-16140# RAND Corp., Santa Monica, Calif.
THE CATALOG: A FLEXIBLE STRUCTURE FOR DATA STORAGE
T. W. Ziehe Nov. 1966 23 p refs Presented at the Conf. on Computers in Humanistic Res., College Station, Tex., 17–18 Nov. 1966
(P-3476; AD-642368) CFSTI: HC $3.00/MF $0.65

Applications that use the computer as a processor of natural languages are considered. The importance of data in these applications requires a general and flexible, yet very efficient, data storage and management system. The basic features of a generalized data structure, called The Catalog, are described. Also described is the encoding scheme that was developed for use with catalogs.
TAB

N67-16209# Illinois Univ., Urbana. Coordinated Science Lab.
ON THE CONNECTION ASSIGNMENT PROBLEM OF DIAGNOSABLE SYSTEMS
F. P. Preparata, G. Metze, and R. T. Chien Oct. 1966 29 p
(Contract DA-28-043-AMC-00073(E); Grants NSF GK-690; NSF GK-36)
(R-322; AD-641118) CFSTI: HC $3.00/MF $0.65

The paper treats the problem of automatic fault diagnosis for systems with multiple faults. The system is decomposed into a number of units u sub 1, u sub 2..., sub n, where a unit is a well identifiable portion of the system which cannot be further decomposed for the purpose of diagnosis. By means of a given arrangement of testing links (connection assignment) each unit of the system tests a subset of units, and a proper diagnosis can be arrived at for any diagnosable fault pattern. Methods for optimal assignments are given for instantaneous and sequential diagnosis procedures.
Author (TAB)

N67-16407# Mitre Corp., Bedford, Mass.
USER'S MANUAL FOR PEST, A MONITOR PROGRAM FOR THE PHOENIX COMPUTER
Max ben-Aaron Oct. 1966 32 p refs
(Contract AF 19(628)-5165)
(MTR-219; ESD-TR-66-301; AD-642353) CFSTI: HC $3.00/MF $0.65

PEST is a non-time-shared program which gives a user access to an editor and an assembler on PHOENIX, a computer developed by the MITRE Corporation. PEST allows the user to enter, edit, assemble, load, debug, and execute a symbolic program.
Author (TAB)

N67-16415# Fein (Louis) Consulting Service, Palo Alto, Calif.
ADAPTIVE SYSTEMS Final Report, Nov. 1, 1964–Oct. 31, 1965
Aug. 1966 55 p refs
(Contract Nonr-4771(00))
(AD-640004) CFSTI: HC $3.00/MF $0.65

It removes the ambiguity of the phrase adaptive machine, if one puts an adaptive machine into one of three categories according to whether or not the machine itself must be changed as it is being designed on the one hand, and as it is being operated, on the other. Adaptive machines are either unadaptively-designed and adaptively-operated, or adaptively-designed and unadaptively-operated, or adaptively-designed and adaptively-operated. A procedure is developed for identifying the possible causes of failure of adaptive machines (belonging to any of the three categories) to answer questions of interest to the Navy and to the scientific community—questions of target recognition, flight control, language translation, weather prediction, or robot construction. For each possible cause of failure, there is, of course, a research

project which, if successful, would serve to eliminate that cause and would bring the Navy a step closer to the realization of practical, adaptive machines. It turns out that there are only five classes of causes of failure and five corresponding classes of research projects. These five classes are: question formulation; question reformulation; method feasibility; machine realizability and designability; machine practicality. This procedure provides a straightforward way of planning directed research programs to successful adaptive systems. A research program is recommended.
Author (TAB)

N67-16442# Stanford Research Inst., Menlo Park, Calif.
SYNTHESIS OF AUTOMATA BY DECOMPOSITION TECHNIQUES Final Scientific Report, Mar. 1965–Sep. 1966
Clarence M. Ablow and Michael Yoeli Sep. 1966 19 p refs
(Contract AF 19(628)-5092)
(AFCRL-66-673; AD-641672) CFSTI: HC $3.00/MF $0.65

The major effort under this research program was devoted to parallel decompositions of single-input automata (autonomous sequential machines) without and with state-splitting. First, decompositions into two smaller automata subject to suitable optimality criteria were considered and computational decomposition techniques were established. Next, indecomposable single-input automata (modules) were characterized and methods were derived for the realization of any specified single-input automaton as parallel composition of such modules. Some results concerning cascade decompositions of single-input automata are also given. The other part of this research program was devoted to establishing a mathematically precise, basic theory for generalized cascade decompositions of partially specified multi-input semi-automata (output-free sequential machines). Earlier work by Yoeli was unified with recent work on complete automata by Zeiger. The concept of homomorphic relation plays an important role in this connection.
Author (TAB)

N67-16483# RAND Development Corp., Cleveland, Ohio.
SYMPOSIUM IN KIEV: COMPUTER TECHNOLOGY AND THE HISTORY OF SCIENTIFIC AND TECHNICAL PROGRESS
V. N. Klimeniuk, K. B. Gel'man-Vinogradov, and L. G. Khromenko 10 Oct. 1966 7 p Transl. into ENGLISH from Istoriya SSSR (USSR), no. 4, Jul.–Aug. 1966 p 232–233
(LT-66-56; TT-66-62470; AD-640504) CFSTI: HC $3.00/MF $0.65

Translation of part of 'History of the USSR', no. 4, July–Aug. 1966; Report on the symposium held in Kiev on computer technology and the history of scientific and technical progress.
TAB

N67-16488# Naval Air Development Center, Johnsville, Pa. Aero Mechanics Dept.
UNIVERSAL ENCODER TESTING SYSTEM Final Report
Eric A. Alfonsi and J. M. K. Bergey 9 Sep. 1966 19 p refs
(NADC-AM-6646; AD-641086) CFSTI: HC $3.00/MF $0.65

The Universal Encoder Tester (UNET) was developed to provide the Navy with an automatic testing system capable of fully evaluating Analog-to-Digital (A/D) Converters. Modifications were undertaken to improve the performance of the system to provide for a simplification of the timing controls and an improved error detection routine. Substantial improvements have been made to increase the functional capabilities of the machine.
Author (TAB)

N67-16495# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
STATE INCREMENT DYNAMIC PROGRAMMING APPLIED TO STOCHASTIC AND ADAPTIVE OPTIMIZATION PROBLEMS
Robert E. Heath, III, J. C. Koger (M.S. Thesis) Jun. 1966 142 p refs
(GGC/EE/66-12; AD-639702) CFSTI: HC $3.00/MF $0.65

Dr. R. E. Larson has proposed an optimization technique, state increment dynamic programming, which reduces the fast digital computer memory requirement of conventional dynamic programming while retaining its many desirable features. The primary modification in state increment dynamic programming is that, instead of a fixed time of application of control as in conventional dynamic programming, the duration of application of control is selected as the time such that no state changes by more than one increment. This guarantees that the state resulting from the application of a control lies in a small neighborhood of the original state. Consequently, the entire region of state space is divided into smaller units called blocks. The smaller amount of information contained in one of these blocks, as compared with the entire region of state space, accounts for the reduction in the fast memory requirement. State increment dynamic programming is applied to stochastic optimization problems in which the stochastic variable is a set of values each with a known discrete probability. The equations are presented in a form suitable for a digital computer solution.
TAB

N67-16557*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DIANA: A DIGITAL–ANALOG SIMULATION PROGRAM FOR THE IBM 1620 II COMPUTER
R. J. Mankovitz 1 Feb. 1967 35 p refs
(Contract NAS7-100)
(NASA-CR-81297; JPL-TR-32-1011) CFSTI: HC $3.00/MF $0.65
CSCL 09B

Diana is a block-oriented interpretive program which can be used to simulate physical systems by solving the simultaneous differential equations describing the systems. The program behaves much like an analog computer, with on-line control and input-output capabilities. Available Diana integration methods include: fifth-order Adams–Moulton, with adaptive step size; fixed-step Adams method; and Runge–Kutta–Gill method.
Author

N67-16590# Stanford Research Inst., Menlo Park, Calif.
A COMPARISON OF SOME CLUSTER-SEEKING TECHNIQUES Interim Report, Jun.–Aug. 1966
Geoffrey H. Ball Griffiss AFB, N. Y., RADC, Nov. 1966 52 p refs
(Contract AF 30(602)-4196)
(RADC-TR-66-514; AD-643287) CFSTI: HC $3.00/MF $0.65

Conventional multivariate statistics examine in considerable depth the significance of relationships existing in data as shown by the mean and the covariance matrix. Shortcomings of this approach are briefly discussed. 'Cluster-seeking techniques' are discussed as alternatives to conventional multivariate methods. Thirty variants of cluster-seeking techniques, the total number presently known to the author, are divided into seven categories: probabilistic, signal detection, clustering, clumping, eigenvalue, minimal mode seeking and miscellaneous. These larger classes are contrasted and, within each class, the techniques are summarized and compared. A composite technique that combines the best features of the various approaches is proposed.
Author (TAB)

N67-16619*# Northrop Space Labs., Hawthorne, Calif.
DEVELOPMENT OF TECHNOLOGICAL CONCEPTS LEADING TO THE BENEFICIAL USE OF LUNAR MAGMA PRODUCTS Technical Progress Report, Oct.–Dec. 1966

E. Azmon Dec. 1966 4 p
(Contract NAS7-358)
(NASA-CR-81339) CFSTI: HC $3.00/MF $0.65 CSCL 08D

It is reported that effort was concentrated on the analysis of gabbro and serpentine, on the completion of analysis of an artificial olivine, and on determining the petrographic properties of cast and formed geometric shapes. A pressure versus temperature genesis diagram for gabbro, and photographs of cast basalt and obsidian dust are included. C.T.C.

N67-16857# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
SEMANTIC MEMORY
M. Ross Quillian Oct. 1966 233 p refs
(Contract AF 19(628)-5065; Grant NIH-MH-07722; ARPA Order 627)
(AFCRL-66-189; SR-2; AD-641671) CFSTI: HC $3.00/MF $0.65

The report describes a model for the general structure of human long term memory. In this model, information about such things as the meanings of words is stored in a complex network, which then displays some of the desirable properties of a human's semantic memory. Most important of these properties is the capability of the memory to be used inferentially; i.e., to allow for the answering of questions besides those specifically anticipated at the time the information is stored in the memory. A computer program is described which illustrates this property by using the memory model inferentially to simulate human performance on a basic semantic task. When the meaning of some segment of natural language text is represented in the format of the model, relationships and features of this meaning must be made explicit which were not explicit in the text itself. This becomes a methodological advantage in an experiment in which a person interprets text, as described. Author (TAB)

N67-16859# Stanford Research Inst., Menlo Park, Calif.
CELLULAR ARRAYS FOR LOGIC AND STORAGE Final Report, 30 Jun. 1964–31 Mar. 1966
Jack Goldberg, Milton W. Green, Jon D. Hopper, William H. Kautz, Robert C. Minnick et al Apr. 1966 326 p refs
(Contract AF 19(628)-4233)
(AFCRL-66-613; AD-643178) CFSTI: HC $3.00/MF $0.65

The report presents the results of second project of research on cellular logic. The objective of the research has been to develop techniques for the efficient realization of general logical functions in microcellular arrays—i.e., cellular arrays in which the cells contain a small number of gates. The report is in seven chapters. The subjects of the chapters are: (I) Introduction, (II) Organization of New Cellular Arrays, and Analysis of Fault Avoidance Schemes, (III) Mathematical Analysis of Cascades and Derivation of Decomposition Algorithms, (IV) Techniques for Practical Logical Design Using Cellular Arrays, (V) A Procedure for Computer-Aided Design of Cellular Arrays, (VI) Design of a Cellularly-Organized Turing Machine, and (VII) Summary and Suggestions for Further Work. Author (TAB)

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N67-15345# Air Force Systems Command, Elgin AFB, Fla. AF Armament Lab.
INVESTIGATION OF A TUNNEL DIODE OSCILLATOR AS AN ANALOG TO DIGITAL CHARGE CONVERTER
Vito William Marinelli (M.S. Thesis—Fla. State Univ.) Oct. 1966 56 p refs
(AFATL-TR-66-88; AD-640584) CFSTI: HC $3.00/MF $0.65

A 10 ma gallium arsenide tunnel diode has been used as an oscillator. The oscillator power supply voltage is adjusted so that the diode is in its low voltage state and cannot oscillate. An amount of charge Q is introduced into the circuit and if this charge is great enough, the circuit oscillates for a short time. The charge Q is introduced in one of two ways: the capacitance is kept constant and the voltage is increased or the voltage is kept constant and the capacitance is varied. It was found that when the charge is introduced by keeping the voltage constant and varying the capacitance, a linear relationship exists between the charge Q and the number of oscillations. However, when the capacitance is constant and the voltage is varied, the circuit reaches a point where an increase in Q causes no increase in the number of oscillations. Author (TAB)

N67-15347# Army Electronics Lab., Fort Monmouth, N. J.
TECHNOLOGY, DESIGN AND APPLICATION OF INTEGRATED CIRCUITS
Aug. 1966 71 p
(ECOM-2747; AD-641642) CFSTI: HC $3.00/MF $0.65

Contents: PART I - TECHNOLOGY - Basic physics; Introduction to integrated circuits; Epitaxial materials - processes, characterization, and applications; Diffusion; Artwork for integrated circuit layouts; Insulated gate field effect transistor; Thin and thick film components; Thin and thick film deposition techniques; Ancillary processes for integrated circuits; Nonconventional IC components and techniques. PART II - DESIGN - Basic transistor design; Integrated circuit design; Linear design techniques; Universal linear circuits; Custom integrated circuits; Comparison of digital logic circuits; MOS digital integrated circuits; Integrated circuit packages and interconnections; State-of-the-art, custom high-frequency circuits; Thin film hybrid integrated circuit design and layout. PART III - APPLICATION - Applications of digital integrated circuits; Application of integrated electronics; Integrated circuit interconnections and subassembly packaging; Microelectronic equipment design factors; Nuclear radiation effects on integrated circuits; Reliability; ECOM equipment support. TAB

N67-15500# Hughes Aircraft Co., Fullerton, Calif.
RADIATION EFFECTS ON (MONOLITHIC) MICROELECTRONIC CIRCUITS Final Report, 1 May 1965–31 Jul. 66
Charles W. Perkins, Robert W. Marshall, and Alan M. Liebschutz Nov. 1966 90 p refs
(Contract DA-28-043-AMC-01313(E))
(Rept.-5; FR-66-17-278; ECOM-01313-F; AD-642301) CFSTI: HC $3.00/MF $0.65

Evaluation of commercial circuits reveals that the better constructed circuits are immune to transient radiation disturbances up to 110 to the 9th power rads (Si)/sec and to permanent damage up to at least 10 to the 13th power N sub (f)vt. Analysis shows that the transient effects originate in the junctions with the substrate. Theoretical expressions are derived for the critical radiation thresholds. On the basis of this analysis, guidelines are set down for the design of monolithic circuits resistant to transient radiation effects. Analysis shows that permanent damage is due to degradation of transistor current gain. Theoretical expressions are derived for the critical radiation thresholds for permanent damage. On the basis of this analysis, guidelines are set down for the design of radiation-hardened monolithic circuits. Author (TAB)

N67-15672*# Northrop Space Labs., Hawthorne, Calif.
SELECTED ELECTRONIC CIRCUITRY—A REPORT
1966 100 p refs Prepared for NASA
(NASA-SP-5046) GPO: $0.70; CFSTI: MF $0.65 CSCL 09A

A summary of specific innovations in electronic-circuit technology which were derived from the space program, and which appear to be useful for general industrial application, is reported. Presented are data on: amplifier circuits; oscillator circuits; multivibrator circuits; power supply and related circuits; wave shaping circuits; temperature compensation circuits; control circuits; specialized computer circuits; and miscellaneous circuits. S.C.W.

N67-15684*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FAILURE RATE COMPUTATIONS BASED ON MARINER MARS 1964 SPACECRAFT DATA
Frank H. Wright 15 Jan. 1967 16 p
(Contract NAS7-100)
(NASA-CR-81192; JPL-TR-32-1036) CFSTI: HC $3.00/MF $0.65 CSCL 09A

This report describes the analysis of spacecraft parts–hours, and failure data from the *Mariner Mars* 1964 program. It contains failure rates for transistors, resistors, capacitors, diodes, transformers, relays, and coils, using the JPL Problem/Failure Reporting system. Failure data origins, ground rules, and definitions are also given. Author

N67-15709*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
VARIATION OF CURRENT WITH VOLTAGE AT THE ONSET OF PUNCH-THROUGH FOR THIN-BASE SOLID-STATE DIODES
A. Shumka *In its* Space Programs Sum. No. 37–41, Vol. IV 31 Oct. 1966 p 38–41 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

Deviations observed between the I-V characteristics of the actual solid-state diodes and the characteristics predicted by the theoretical model for the solid-state diodes in the low current range for the thinner base samples indicated that probably the assumptions of a fixed base width and a zero voltage drop across the emitter were not valid. Theoretical calculations were performed, and the results clearly show the influence of the emitter junction on the I-V characteristics to be appreciable in the low current range when the width of the transition region is comparable to that of the base. The modified theory is in good agreement with the experiment. Author

N67-15711*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PERFORMANCE OF AN ELECTRON GUN
K. Shimada *In its* Space Programs Sum. No. 37–41, Vol. IV 31 Oct. 1966 p 46–50 refs (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

In order to permit application of an external magnetic field to the emitter region of our research diode, an electron gun was designed and assembled in our laboratory. The gun produces a pencil-sized electron beam which originates at a filament located over 4 in. from the target (emitter). The electron gun has semispherical electrodes and has operated successfully at a beam power of approximately 300 w. At this power level, a beam efficiency of 85% was recorded. Author

N67-15750*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ELECTRON TUBE FILAMENT STUDY
L. J. Derr *In its* Space Programs Sum. No. 37-41, Vol. IV 31 Oct. 1966 p 228–233 refs (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

A study conducted to develop methods which would enhance the efficiency of heat transfer between the filament and cathode of electron tubes is described. Numerous designs were tested such as nickel imbedding, molybdenum–nickel imbedding, flat spiral heaters, Sauereisen imbedding, Cermabond imbedding, flame-spray imbedding, and monolithic structures. The performance data on each assembly tested are summarized and show the heating power needed for each unit to reach the brightness temperature of a reference tube. Excellent characteristics are recorded for the monolithic structure which lends itself to compact, rugged electron tube construction, and could feasibly be used for high impact applications. A.G.O.

N67-15763*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
EXPERIMENTAL STUDY OF MULTIPACTING BETWEEN COAXIAL ELECTRODES
R. Woo *In its* Space Programs Sum. No. 37-41, Vol. IV 31 Oct. 1966 p 242–247 refs (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

The multipacting effect occurring between coaxial electrodes separated by a few centimeters in the frequency range of 10–150 MHz in a high vacuum environment was experimentally studied. Minimum and maximum breakdown voltages were measured, and the procedures used to obtain these voltages at the electrodes, by means of an RF amplifier, are described. Plots of the breakdown voltage for several cases of varying electrode separation distances, and with 50 ohm impedance coaxial electrodes are given. In addition to the scaling studies, a computer program was written to solve the equation of electron motion between coaxial electrodes. For the scaling experiments, the similarity principle predicts that the cases should coincide. Agreement is within experimental and reproducibility error except for the minimum energy boundary which decreases with a decrease in electrode size. The results bear out predictions made by the similarity principle and computer studies reported for previous experiments conducted with coaxial electrodes where the ratio of outer to inner radii was 2.3. Further experiments with higher ratios of outer to inner radii are being conducted. L.S.

N67-15763*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DIGITAL DEVICES DEVELOPMENT: INTEGRATED CIRCUITS-DELAY LINE INTERFACE CIRCUITRY
R. A. Winklestein and E. Lutz *In its* Space Programs Sum. No. 37-41, Vol. IV 31 Oct. 1966 p 278–283 refs (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

A system of interfacing ultrasonic delay lines within digital systems using integrated circuit logic is described. The basic technique is to store digital information of an aperiodic nature in the delay medium and to retrieve an exact replica of that information delayed by a certain amount. The system operates in the NRZ mode, maintaining the high bit density capability of this mode but with much higher noise immunity than conventional schemes. It is reported that the prototype system has proved to be satisfactory and has sufficient flexibility to insure reliable and repeatable operation. It is also noted that the system may be used in the development of high frequency memory systems featuring glass delay lines. A.G.O.

N67-15793*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ACCELERATED LIFE TESTING OF TRANSISTORS
E. Klippenstein *In its* Space Programs Sum. No. 37-40, Vol. 4 31 Aug. 1966 p 36 (See N67-15781 06-34) CFSTI: HC $3.00/MF $0.65

The difficulties existing in validly relating the performance characteristics resulting from accelerated tests to the performance

characteristics that would be obtained at stress conditions of normal use are discussed, in conjunction with accelerated testing techniques. Also summarized are the preliminary steps taken in a program to study the techniques of accelerated testing and to determine the acceleration obtained by both incremental increases in stress and high constant stresses. A brief report is included on the base-emitter voltage method of determining thermal resistance. M.G.J.

N67-15794*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DEVELOPMENT OF WIRECON UTILITY TEST MODULE
E. R. Bunker, Jr. *In its* Space Programs Sum. No. 37-40, Vol. 4 31 Aug. 1966 p 37–40 (See N67-15781 08-34) CFSTI: HC $3.00/MF $0.65

Engineering details are given on a small electronic module, using cordwood packaging on the Wirecon (wire-connected) header packaging approach. This utility module can be used as a standard configuration for tests of operation at temperature extremes; evaluation of the embedment pressures generated by various encapsulement systems on electronic components; and the effects of sterilization. Schematics, depicting the module configuration, the jumpers for flip-flop operation, and the interconnection of Wirecon modules, amplify the text. Three configurations were constructed and tested: a breadboard, a twice scale model module, and a normal scale module. Test results show that all three performed nearly identically; however, at the higher pulse rates, the effect of lead length in the breadboard module became serious at the 100-kHz repetition frequency. M.G.J.

N67-15843*# National Aeronautics and Space Administration, Washington, D. C.
DETERMINATION OF DEFECTS IN SILICON p-i-n DETECTORS OF NUCLEAR RADIATION [O VYYAVLENII DEFEKTOV V KREMNIYEVYKH p-i-n DETEKTORAKH YADERNYKH IZLUCHENIY]
L.G. Yuskeseliyeva Dec. 1966 11 p refs Transl. into ENGLISH from Joint Inst. for Nucl. Res. Rept. No. JINR-P-2489, 1965 p 1–14
(NASA-TT-F-10442) CFSTI: HC $3.00/MF $0.65 CSCL 18D

Defects in *p–n* junction of silicon *p–i–n* detectors were investigated by electrophotography and electrochemical depositing of copper. The study of the defects is associated with electric characteristics of detectors. Author

N67-15964# Defense Dept., Washington, D. C.
A STRIP-FORM ITERATED TRAVELING WAVE PARAMETRIC AMPLIFIER USING SERIES CONNECTED DIODES
Arthur D. Sills 30 Nov. 1966 250 p refs
(AD-642766) CFSTI: HC $3.00/MF $0.65

The theoretical investigation includes derivations of expressions for gain and noise figure. Phase conditions necessary for maximum gain (synchronism) are included. Both iterative and distribution amplifiers are analyzed and the expressions for gain, synchronism and noise figure are shown to converge to the same results. For comparison purposes, the shunt connected iterative and distributed amplifiers are also analyzed. Computer programs are written comparing iterative series and shunt amplifiers with respect to gain and noise figure. Results are shown in graphical form over the passband of the amplifiers. Author (TAB)

N67-15972# Texas Instruments, Inc., Dallas. Semiconductor-Components Div.
THIN FILMS FORMED BY ELECTROCHEMICAL REACTIONS Final Report, 1 Jun. 1963–31 May 1966
Michael J. F. Gaze Ft. Monmouth, N. J., Army Electron. Command, Oct. 1966 54 p refs
(Contract DA-36-039-AMC-02324(E))
(TI-03-66-98; ECOM-02324-F; Rept.-10; AD-641613) CFSTI: HC $3.00/MF $0.65

Resistors formed by reactively sputtered tantalum in oxygen have been produced with a practical upper sheet resistance limit of 300 ohms/sq in. The temperature coefficient of the oxygen doped tantalum resistors is generally less than 150 ppm/C. The temperature coefficient can be reduced by gold doping the tantalum-tantalum oxide mixture. Tantalum oxide dielectrics have been deposited by reactive sputtering in oxygen. The dielectric constant is 21, dielectric strength 0.025 V/A and dissipation factor from 1 to 2%. The practical upper limit on capacitance per unit area is 0.35 pF/sq mil or 0.35 microfarads/sq in. It has been found that the addition of low resistivity semi-conducting MnO2 to the capacitor structure greatly increases the free-from-shorts-yield. The causes of instability in the deposited resistors has been investigated and the faults corrected by a specially designed sputtering unit. The resistor and capacitor development was accomplished using silicon as the substrate material. This simulates combining the resistor and capacitor with diffused silicon devices to form hybrid structures. Author (TAB)

N67-15996# Hughes Aircraft Co., Fullerton, Calif.
EFFECT OF TRANSISTOR DESIGN PARAMETERS ON RADIATION RESPONSE (POWER TRANSISTORS) Final Report, 1 Jul. 1965–30 Jun. 1966
V. R. Honnold, G. D. Thomas, and J. J. Mazenko Ft. Monmouth, N. J., Army Electron. Command, Oct. 1966 84 p refs
(Contract DA-28-043-AMC-01541(E))
(FR-66-17-267; ECOM-01541-F; Rept.-4; AD-641406) CFSTI: HC $3.00/MF $0.65

An investigation of design effects on the radiation resistance of a silicon planar power transistor is presented. This research was a joint theoretical and experimental study of methods to modify existing fabrication techniques to produce a power transistor which would minimize the deleterious effects of transient ionizing and displacement producing radiation. The theoretical model was developed by combining a one dimensional base transport equation with the appropriate corrections for high level injection effects. The resulting radiation design equation expresses the radiation resistance of the transistor in terms of the fundamental design parameters which were studied experimentally. The critical physical design parameters were varied in a statistically designed experiment to determine the optimum combination of processing techniques which would maximize the radiation resistance while preserving the useful electrical characteristics of the device. On the basis of these results, the optimum design parameters and processing techniques were combined to evaluate a prototype radiation resistant transistor. Author (TAB)

N67-16009*# National Academy of Sciences–National Research Council, Washington, D. C.
RADIO ELECTRONICS
In its Progr. in Sci. Radio 1966 p 347–371 (See N67-16001 06-34) CFSTI: HC $3.00/MF $0.65

Studies on low-noise devices covered the following topics: (1) *Low-Noise Parametric Amplifiers*–development of maser-like amplifiers, broadband amplifiers, and amplifier cooling by incorporation of closed-cycle refrigerators; (2) *Nonlinear Optics and Laser Radar*–nonlinear optical and optical-frequency conversion, laser radar systems, red response of photoelectric detectors, moon observations by laser optics, and laser measurements of high voltage current transmission lines; (3) *On Continuous-Wave Lasers, Gas Lasers, and Holography*–state-of-art in lasers, and laser

application in holography; (4) *Microminiaturization*–advances in microelectronics, silicon monolithic integrated circuits, metal-oxide-silicon field-effect transistors, and thin film circuits; (5) *Solid-State Plasmas, Helicons, and Gunn Effect*–spatial and temporal electromagnetic fluctuations, electromagnetic wave propagation in solid conductors, and negative conductance of electron transfer in strong electric field; (6) *Cryogenic Coils*–superconducting magnet technology, cryogenic environment, and magnet application. G.G.

N67-16035# General Electric Co., Schenectady, N. Y. Research and Development Center.
THE GALLIUM ARSENIDE THIN-FILM SWITCHING DIODE
J. R. Richardson *In its* New Solid-State Device Concepts Sep. 1966 p 35–46 refs (See N67-16029 06-26) CFSTI: HC $3.00/MF $0.65

Details are given on the controlled evaporation of gallium arsenide by the three-temperature method, and the procedure which was adopted is outlined. Using this technique, the rate of gallium and arsenic atoms impinging on the substrate can be measured separately, along with the net deposition rate of gallium arsenide. The dependence of the optical and electrical properties of thin film gallium arsenide was also studied, with emphasis focused on the influence of the substrate temperature. Seven films were evaporated at a rate of 0.5 μ g/cm^2 sec onto quartz substrates at temperatures between 20° and 575°C; room temperature resistivity and the optical absorption as a function of wavelength were measured. Results show that for substrate temperatures below 250°C the films are grossly imperfect. Resistivity approaches 10 ohm–cm for films prepared between 250°C and 350°C, while for substrates at high temperatures it appears as if defects tend to compensate the films and produce semi-insulating gallium arsenide. M.G.J.

N67-16057*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
BIPOLAR ANALOG-TO-PULSE-WIDTH CONVERTER
Robert H. Nixon 15 Jan. 1967 23 p refs
(Contract NAS7-100)
(NASA-CR-81252; JPL-TR-32-1034) CFSTI: HC $3.00/MF $0.65 CSCL 09F

This Report describes the design and application of a bipolar analog-to-pulse-width converter circuit module that was developed for the implementation of analog-to-digital conversions in spacecraft systems. The converter module, along with appropriate digital logic, has unique application in performing analog-to-digital conversions in environments where low-level measurements must be made in the presence of system noise. Sufficient electrical and mechanical design details are given to allow the fabrication of spacecraft-quality circuit modules. The design presented has been qualified for use on the *Mariner* spacecraft and on the OGO-E and Bioscience satellites. Author

N67-16172# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE OPERATIONAL RELIABILITY OF ELECTRONIC EQUIPMENT
Petre Sipos 18 Apr. 1966 23 p refs Transl. into ENGLISH from Telecommunicatii (Bucharest), v. 8, no. 2, 1964 p 73–78
(FTD-TT-65-1166; TT-66-62523; AD-641112) CFSTI: HC $3.00/MF $0.65

Conclusions: (1) Knowledge of probability calculations and mathematical statistics is necessary for successful solution of problems in operational reliability. In general, statistical methods do not present especially difficult problems in the study of reliability. Usually, the difficulty consists in logical statement of the given problem. In the same way, statistics provide the theoretical basis for many practical solutions, which are purely intuitive in most cases. (2) Standardization and miniaturization of components is an important means for increasing the reliability of electronic equipment. Additionally, when it is economically and technically reasonable, it is recommended that components that have a high failure risk be kept as spares. To increase reliability further it is also necessary to choose reliable components, adequate operating conditions, and finally, to make failure predictions. (3) It is absolutely necessary to establish reliability standards for the various types of electronic equipment. For this it is necessary to use one of the most complete reliability characteristic, such as the average duration of normal operation. These reliability standards must be introduced in the early design stages. (4) It is necessary to establish an adequate terminology for reliability theory; the terminology used in this article is not to be considered definitive. (5) As the quantities and complexity of electronic equipment increase, it is absolutely necessary that reliability be considered as one of the most important parameters of the equipment. Author (TAB)

N67-16192# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
PRODUCTION ENGINEERING MEASURE FOR SILICON LINEAR INTEGRATED CIRCUITS Quarterly Progress Report, 20 Apr.–20 Jul. 1966
Thomas Quaid, Marvin Carpenter, and William Turner Aug. 1966 77 p
(Contract DA-36-039-AMC-06158(E))
(QPR-5; AD-642343) CFSTI: HC $3.00/MF $0.65

The last of the engineering model integrated circuits, the mixer-oscillator (SC1709), was evaluated and found acceptable thereby completing the engineering phase of this program. The program is now well into the preproduction phase with both preproduction integrated circuits and receivers presently being fabricated and tested. Author (TAB)

N67-16202# Army Electronics Labs., Ft. Monmouth, N. J.
CAPACITOR CHARACTERISTICS OF ANODIZED THIN-FILM HAFNIUM
Aubrey J. Raffalovich Sep. 1966 36 p refs
(ECOM-2758; AD-641338) CFSTI: HC $3.00/MF $0.65

Capacitors were fabricated from anodized hafnium films previously sputtered onto glass slides. The sputtering rate was 108 A/min. Anodization was accomplished at 46 volts, the electrolyte being 0.5 N. aqueous ammonium sulphate and the anodization rate 57 A/V. The counter electrode was vacuum-deposited gold. Variations in the anodic technique caused little or no improvement in capacitor characteristics. Characteristics found were: K = 50, capacitance = 1.1 microfarads/sq in, dissipation factor = 1.3%, TCC = 200 ppm/C, voltage breakdown = 75% of formation voltage, and current leakage = 3.0 to 4.5 x 10 to the minus 8th power amps/sq in at the knee formed at 18 V. The insulation resistance at 18 V was 2.0 to 3.0 x 10 to the 10th power ohms (1.0 to 1.5 x 10 to the 8th power ohms/sq in). There are indications that the films are relatively non-polar. There is a wicking of electrolyte during the anodization process. TAB

N67-16246# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
TIME-TO-PULSE-HEIGHT CONVERTER [UKLADY ZAMIANY CZASU NA AMPLITUDE]
Z. Hoffman and A. Sawicki *In its* Nukleonika, Vo. VIII 1966 p 191–195 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

A circuit was designed to adapt a 100-channel pulse height analyzer for selecting pulses according to their transit time. The

circuit analyzes pulses according to the time of flight of resonance neutrons. The operating principles of the circuit and its delay circuit, sawtooth generator, gate, pulse forming circuit, and comparison circuit are described. A schematic diagram of the converter is included. The circuit was tested with a multichannel pulse height analyzer which had its linearity checked by measuring known nuclear resonances. These measurements showed that the stability of the channel width and the linearity of the time-to-pulse-height conversion are better than 1%. R.N.A.

N67-16258# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
STABILIZING THE AMPLIFICATION FACTOR OF EMI 6097-F AND FEU-29 PHOTOMULTIPLIERS [STABILIZACJA WSPOLCZYNNIKA WZMOCNIENIA FOTOPOWIELACZY EMI 6097-F ORAZ FEU-29]
E. Chrusciel and S. Kwiecinski *In its* Nukleonika, Vol. VIII 1966 p 250–253 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The constant amplification factor of photomultipliers employed in gamma spectrometry rests on efficient stabilization through careful selection of resistance and voltage battery; asymmetry of the voltages between the dynodes increases the voltage in the neighboring dynodes and leads to increased amplification during change in focusing conditions. In tests with photomultipliers in an electric circuit, current diminishes by as much as ten times with an asymmetrical divider as compared with a current using a symmetrical divider. G.G.

N67-16259# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
SEMICONDUCTOR HIGH-STABILITY DC SOURCE [POLPRZEWODNIKOWE WYSOKOSTABILNE ZRODLO NAPIECIA STALEGO]
K. Pasiewicz *In its* Nukleonika, Vol. VIII 1966 p 254–257 (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

Described is a stabilized power unit which employes a regulator to keep the voltage stable. The regulator is a variable resistance transistor in the load-current circuit of the voltage source, the feedback amplifier is a differential circuit in which a pair of resistors provide amplification and zero collector current, and the next amplification stage is a transistorized circuit. Final temperature compensation in the completed circuit is made by an avalanche germanium diode. When the voltage drop across the controlled resistance increases, the avalanche diode is unblocked and increases the resistance of the transistor thus limiting the overall current. G.G.

N67-16260# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
LOW-NOISE CHARGE-SENSITIVE PREAMPLIFIER FOR USE WITH SEMICONDUCTOR NUCLEAR RADIATION DETECTORS [NISKOSZUMOWY PRZEDWZMACNIACZ IMPULSOWY CZULY NA LADUNEK DO WSPOLPRACY Z POLPRZEWODNIKOWYMI DETEKTORAMI PROMIENIOWANIA JADROWEGO]
M. Dakowski and M. Sowinski *In its* Nukleonika, Vol. VIII 1966 p 258–262 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The stability of a detector preamplifier can be increased by one order of magnitude, as compared with ordinary voltage preamplifiers, by applying negative feedback at the grid of the first tube. Such a circuit insures an output pulse height independent of the capacitance of the semiconductor detector if: $kC_0 \geq C_{det}$ where k is the amplification of the input stage without the feedback loop, C_{det} is the detector capacitance, and C_0 is a small capacitor installed at the grid. G.G.

N67-16292# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
TRIPLE PULSE GENERATOR [GENERATOR IMPULSOW POTROJNYCH]
R. Bayer *In its* Nukleonika, Vol. VIII 1966 p 535–538 (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

This generator is used to study the resolving power and dead time of circuits used in nuclear research. It can be employed to trigger off pulse circuits and also to provide delayed pulses. At its output it gives three synchronized pulses of adjustable width, delay and height. These adjustments are independent and one, two, or three pulses can be obtained at the output. Author

N67-16323# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
COINCIDENCE SPECTROMETER WITH ENERGY SUMMING FOR LOW-ENERGY GAMMA-RAYS [STSINTILLYATSIONNYI MENENIEM METODOV SOVPADENII γ-IZLUCHENIYA S PRI-SPEKTROMETR DLYA MYAGKOGO I SUMMIROWANIYA]
J. Ludziejewski and J. Bialkowski *In its* Nukleonika, Vol. VIII 1966 p 783–791 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

A fast coincidence circuit, gate and linear summing circuit are described. The efficiency of the fast coincidence circuit and its resolving time are 100% and 24 msec, respectively, for a gamma-ray energy of about 50 KeV (for E$\lambda \cong$16 KeV the efficiency is 90%). Linear gate circuit is up 100 volts. "Pedestal" is not more than 0.5 volt. Each branch of the summator gives linear pulses up to above 100 volts. Author

N67-16330# Melpar, Inc., Falls Church, Va.
TROPICAL SERVICE LIFE OF ELECTRONIC PARTS AND MATERIALS Final Report, 1 Jun. 1965–31 May 1966
B. H. Dennison and W. B. Morrow Ft. Monmouth, N. J., Army Electron. Command, Oct. 1966 177 p refs
(Contract DA-28-043-AMC-01346(E))
(ECOM-01346-F; AD-641172) CFSTI: HC $3.00/MF $0.65

A report is made of an effort to evaluate the degree and extent of degradation of selected electronic components in tropical environments over an extended period of time. The components are the type commonly employed in the fabrication of equipment designed for tactical use by the armed services. The component complement consists of units with industry and service acceptance of over a dozen years as well as recent additions resulting from the pressure and trend toward microminiaturization. TAB

N67-16337# Corning Glass Works, Raleigh, N. C. Electronics Div.
PRODUCTION ENGINEERING MEASURE FOR SUBMINIATURE, HIGH RELIABILITY CERAMIC CAPACITORS Quarterly Progress Report, 13 Jun.–30 Sep. 1966
G. L. Watson, III 30 Sep. 1966 54 p refs
(Contract DA-36-039-AMC-06186(E))
(QPR-1; AD-642768) CFSTI: HC $3.00/MF $0.65

Capacitors using an upset lead, which offers economic advantages and performance improvements over the present clip lead, were made and submitted to the Quality Control Lab for process improvement tests during the quarter. Molding compound tests conducted during the quarter did not result in meaningful

data because of other variables that are related to the glaze. Therefore, effort was placed on improving our present 760 ON glaze. Parts were made with 760 OQ glaze (which is different in glass composition from the 760 ON glaze) and tested. Two refinements of the 760 OQ glaze, 760 OY and 760 OZ, were made and tested. The 760 OZ glaze did not offer any advantages over the 760 OQ glaze and was dropped from further consideration. Capacitors made with the 760 OQ and 760 OY are still on test. Several gold pastes were tried as electrode materials during the quarter. Capacitors fabricated with two of these materials are now on test. Parts made with GP-1 and 760 OQ glaze have passed four groups of the process improvement test and have gone 305 hours on life without any failures. Two modifications of our present silvering solution and a different applicating technique have been successful in reducing the cracks in the silver but not successful in controlling the thickness of the silver. Author (TAB)

N67-16370# IIT Research Inst., Chicago, Ill.
FAILURE MECHANISMS IN RESISTORS Final Report, 3 Feb. 1965–3 Jun. 1966
F. R. Hand, M. Goldberg, and W. Brennan Griffiss AFB, N. Y., RADC, Oct. 1966 106 p refs
(Contract AF 30(602)-3614)
(RADC-TR-66-495; E6042-14; AD-641858) CFSTI: HC $3.00/MF $0.65

The accomplishments in the study of the failure mechanisms in metal thin film resistors is presented. The films studied were of the same type employed by several of the major manufacturers of thin film resistive networks. Experiments were carried out to identify the principal physical mechanisms contributing to the degradation of these devices. Chief among these were homogenization of the film composition, stress relief, and ion migration. A computer analysis of manufacturers test data was carried out to determine the nature of the behavior function. The computer was also used to derive from experimental data, an empirical expression for the test resistors as a function of environment, deposition parameters, and time. As a part of this program, the Fourth Annual Physics of Failure in Electronics Symposium was conducted. An evaluation of the symposium is presented. Author (TAB)

N67-16376# Weston Instruments, Inc., Newark, N. J.
TITANIUM DIOXIDE ACTIVE FILM Final Report, Jun. 1965–Feb. 1966
R. L. Peterson, William C. Peterson, R. Evans, J. P. Cirillo, M. Brelinsky et al Griffiss AFB, N. Y., RADC, Oct. 1966 80 p refs
(Contract AF 30(602)-3827)
(RADC-TR-66-467; XS-11798-11800; AD-642056) CFSTI: HC $3.00/MF $0.65

Laboratory models of thin film diodes with the Ti-TiO2-Ag configuration were developed and their characteristics studied. High static rectification ratios were obtained on specimens made under reproducible conditions. The functional dependence of current and capacitance on voltage indicated space charge limited current flow. Temperature and frequency dependence were analyzed. Stability under no-load and load conditions were reasonably good. Author (TAB)

N67-16381# Princeton Univ., N. J. Plasma Physics Lab.
EVALUATION OF ARC DAMAGE TO POWER TRIODE GRID WIRES
G. Bronner, J. G. Murray, and J. P. Sorrentino Sep. 1966 35 p ref Presented at the Symp. on Engineering Probl. of Controlled Thermonuclear Res., Gatlinburg, Tenn.
(Contract AT(30-1)-1238)
(MATT-383; CONF-661016-16) CFSTI: HC $3.00/MF $0.65

Experiments involving aluminum foil damage tests and a simulated grid structure were performed in order to relate such tests to the minimum energy required to damage the grid structure of a type A-15186C tube. In the case of foil tests conducted in air, it was shown that the energy in a particular fault is related to the foil hole size and is in close agreement with engineering calculations and published data. In a vacuum arc gap the damage is much less than indicated by the air foil test. The arc becomes mobile and the energy dissipation appears widespread over the surface area rather than being concentrated or anchored in a spot. With energies up to 100 J and charges up to 0.25 C, more than 100 pulses were required to damage simulated grid wires to the extent where breakage occurred. On a single shot basis energies in excess of 300 J were required to produce damage. Author (NSA)

N67-16388# California Univ., Livermore. Lawrence Radiation Lab.
THE FABRICATION OF SHALLOW, DIFFUSED SILICON DIODES
R. Kalibjian and J. P. Henz 22 Apr. 1966 16 p refs
(Contract W-7405-ENG-48)
(UCRL-14651) CFSTI: HC $3.00/MF $0.65

A detailed description of the fabrication of shallow, diffused silicon diodes is presented. For 0.021-in. thick wafers with a guard-ring geometry, the breakdown voltage of the diodes is in the 500 to 800 v range with the leakage current in the 10^{-7} A range. Author (NSA)

N67-16418# Microwave Associates, Inc., Burlington, Mass.
VARIABLE CAPACITANCE DIODE PRODUCTION ENGINEERING MEASURES PROGRAM Quarterly Report, 27 Jun.–27 Sep. 1966
Henri R. Chalifour Sep. 1966 38 p refs
(Contract DA-36-039-AMC-06181(E))
(QR-1; AD-641410) CFSTI: HC $3.00/MF $0.65

The series resistance of a tuning varactor is broken down into its components and the component resistances are analyzed in order to determine the relative magnitude of each. The result of this analysis suggests techniques which may be employed to fabricate the devices of this contract. The small area devices appear to have a close tolerance on base width and, therefore, a dimensionally exact process is implied. The tolerance on the large area diodes is not as critical and a less exact process may be used. Author (TAB)

N67-16421# CTS Knights, Inc., Sandwich, Ill.
PRODUCTION ENGINEERING MEASURES. VHF QUARTZ CRYSTAL UNITS CR-(XM-38)/U 150 MC to 200 MC Quarterly Report, 1 Jan.–30 Mar. 1966
30 Mar. 1966 31 p
(Contract DA-36-039-SC-85973)
(QR-8; AD-641606) CFSTI: HC $3.00/MF $0.65

Problems encountered in measuring the aging of 9th overtone units (150 mc to 200 mc) on their third overtones are discussed, with samples of data showing frequency variations resulting from the instability of the oven-oscillator testing equipment. Author (TAB)

N67-16444# Army Electronics Labs., Fort Monmouth, N. J.
FAST MILLIMETER FERRITE LATCHING SWITCH
Richard A. Stern and John P. Agrios Sep. 1966 19 p refs
(ECOM-2757; AD-642143) CFSTI: HC $3.00/MF $0.65

A latching single-pole double-throw ferrite switch has been designed and fabricated which operates in the 36 GHz frequency

region. The switch consists of a folded T, a short slot hybrid and two 90 degrees latching non-reciprocal ferrite phase shifters. The switch exhibits an insertion loss of less than 0.75 db and an isolation of greater than 26 db over the frequency range of 35.9 to 37.0 GHz at a peak power of at least 50 KW. The energy required to switch the microwave energy from one port to the other at a speed of one microsecond is 20 microjoules. The switch has been successfully switched at 40 nanoseconds with a switching energy of approximately 100 microjoules. Author (TAB)

N67-16457# California Univ., Berkeley. Electronics Research Lab.
REDUCTION OF NOISE IN CROSSED-FIELD MICROWAVE AMPLIFIERS Interim Report
N. R. Mantena Oct. 1966 217 p refs
(Contract DA-36-039-AMC-02164(E))
(ERL-66-17; ECOM-02164-1; AD-643059) CFSTI: HC $3.00/MF $0.65

The conditions for low-noise operation are established to be the following: (1) The use of a well-focused beam, (2) Reduction of the diocotron gain of the gun and drift regions to a minimum possible value, (3) Full exploitation of magnetic and spacechange smoothing for maximum reduction of noise figure, (4) Launching the beam very close to the circuit, (5) Reducing the space-charge parameters close to zero, (6) High power gain, and (7) Minimizing the initial beam position fluctuations by reducing the cathode thickness. By combining optimum beam focusing, space-charge smoothing, and beam displacement, low noise figures of 10.5 db for the backward-wave amplifier and 18.4 db for the forward-wave amplifier have been obtained without using noise transducers. A better control of the above factors than was possible with the present experimental tube will result in still lower noise figures. With the noise transducing scheme added to the factors listed above, it should be possible to obtain extremely low noise figures as was done by Wadhwa and Van Duzer. Author (TAB)

N67-16476# Massachusetts Inst. of Tech., Cambridge. Lab. for Insulation Research.
A CAPACITANCE BRIDGE ASSEMBLY FOR DIELECTRIC MEASUREMENTS FROM 1 HZ TO 40 MHZ
R. E. Charles, K. V. Rao, and W. B. Westphal Oct. 1966 31 p refs
(Contracts Nonr-1841(10); AF 33(616)-8353)
(TR-201; AD-643169) CFSTI: HC $3.00/MF $0.65

A capacitance bridge is described for measurement of two-terminal capacitors to 80 PF with a nominal loss-tangent sensitivity of 10.000001 radians for samples >10 PF. Provisions for three-terminal measurements are included for frequencies from 1 to 100,000 Hz. Author (TAB)

N67-16492# International Business Machines Corp., Owego, N. Y. Electronics Systems Center.
STUDY OF EFFECT OF HIGH-INTENSITY PULSED NUCLEAR RADIATION ON ELECTRONIC PARTS AND MATERIALS (SCORRE) Final Report, 15 Jun. 1964–15 Jul. 1966
Paul G. Boczar, Wayne A. Cordwell, Gilbert E. Boyd, and Frank A. Frankovsky Ft. Monmouth, N. J., Army Electron. Command, Oct. 1966 73 p refs
(Contract DA-28-043-AMC-00212(E))
(IBM-66-521-13; ECOM-00212-F; Rept.-6; AD-641873) CFSTI: HC $3.00/MF $0.65

The report describes the radiation-induced behavior of tantalum-oxide, mica, ceramic, Mylar, glass, and polystyrene capacitors using results obtained at several sources. Also included are discussions of the following: Experimental techniques at each radiation source, including measurement of circuits, components, dosimetry, and variation of circuit and radiation parameters; Results from SPRF, LINAC, and AFXR tests describing the dependences of the induced current for the irradiated dielectric; Interpretation of these results in terms of appropriate models and radiation and circuit parameters; Comparison of the effects observed at each irradiation source; Description of the tests on magnetics and the test results. Author (TAB)

N67-16582# Silicon Transistor Corp., Garden City, N. Y.
PRODUCTION ENGINEERING MEASURE FOR 50-AMPERE SILICON POWER TRANSISTORS Quarterly Progress Report No. 1, May 27–Aug. 26, 1966
A. Licata and A. Palmerini 26 Aug. 1966 48 p
(Contract DA-36-039-AMC-06185(E))
(QPR-1; AD-641411) CFSTI: HC $3.00/MF $0.65

Significant progress was made in the process improvement work. A molybdenum disk was introduced in the solder joint. Test data shows that the failure mode due to silicon pellet cracking was eliminated. Two new pellet designs were used and some devices with the new pellets were evaluated. It was found that the round pellet resulted in satisfactory pellet yield and device yield. Author (TAB)

N67-16589# General Electric Co., Irmo, S. C. Electronic Specialty Capacitor Business Section.
PRODUCTION ENGINEERING MEASURE FOR IMPROVED RELIABILITY OF HERMETICALLY SEALED TANTALUM FOIL CAPACITORS Fourth Quarterly Report, 20 Jun.–30 Sep. 1966
R. M. Trewhella 20 Sep. 1966 25 p
(Contract DA-36-039-AMC-06169(E))
(QR-4; AD-642317) CFSTI: HC $3.00/MF $0.65

The product improvement evaluation program was completed with the necessary information included in the final design and processing of the reliability proof test units in the production run. In general, the capacitors with the standard electrolyte resulted in parameters with less variance than the capacitors with the replacement electrolytes. The foil type, oxide formation, and method of aging factors did not have an appreciable effect on the product reliability performance. Efforts continued on the fabrication of the 9,150 test capacitors in the production run with approximately 94 percent of the units completing manufacturing. The reliability proof test was started with some 3,085 capacitors put on test to date. Author (TAB)

N67-16594# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
PRODUCTION ENGINEERING MEASURE FOR INSULATED GATE FIELD EFFECT TRANSISTORS Second Quarterly Progress Report, 1 Mar.–31 May 1966
James K. George, Dale Reinke, Myint Hswe, and Harry Forehand 31 May 1966 78 p
(Contract DA-36-039-AMC-06174(E))
(V-21; AD-641401) CFSTI: HC $3.00/MF $0.65

The work centered mainly in four areas: two new photolithographic mask sets were devised to insure the necessary geometrical variations were investigated. These new sets will enable both epitaxial and nonepitaxial techniques to be more fully developed; stable processing steps were formulated with results shown on capacitance-voltage plots; advanced devices were fabricated using information obtained from the initial production group; reliability information was compiled and certain conclusions were drawn. Author (TAB)

N67-16597# Sylvania Electric Products, Inc., Woburn, Mass.
RELIABILITY SCREENING USING INFRARED RADIATION Final Report, Jun. 1964–May 1966
Bernard Selikson and Joseph Di Mauro Griffiss AFB, N. Y., RADC, Oct. 1966 132 p refs
(Contract AF 30(602)-3452)
(RADC-TR-66-360; AD-642112) CFSTI: HC $3.00/MF $0.65

A program was conducted to determine the feasibility of developing a process whereby transistors which have a high probability of failing during their lifetime can be screened from a lot of similiar but reliable transistors on the basis of their infrared output while operating under normal electrical conditions. The report includes discussions of the mode of operation of the infrared instrumentation used in the program and details of the life tests which were conducted. Author (TAB)

N67-16600# Northrop Corp., Newbury Park, Calif. Applied Research Dept.
STUDY FOR GENERALIZED MODEL FOR SEMICONDUCTOR RADIATION RESPONSE PREDICTION Fifth Quarterly Progress Report, 15 Feb.–14 Jun. 1966
J. Raymond and R. Johnson 14 Jun. 1966 158 p refs *Its* Rept.-5
(Contract DA-28-043-AMC-00423(E))
(ARD-66-49R; ECOM-00423-5; AD-640585) CFSTI: HC $3.00/MF $0.65

The detailed bipolar transistor model has been extended to the general large-singal electrical and radiation-induced switching responses. Circulations have been made on the delay, rise, storage, and fall times resulting from electrical or radiation-induced common-emitter response. The radiation-induced transient response has been measured over the range of 0.3 to 100 rads (Si) in a nominal 0.2 microsecs pulsed radiation environment. Radiation environments were the Nortronics 600-kv Flash x-ray and 10-Mev electron irradiation from the General Atomic LINAC. A brief comparison is made between measured and calculated electrical and radiation-induced responses. The lumped-model analysis has been extended to the circuit elements of junction- and dielectrically isolated integrated circuits. Considered are the resistor, diode, and transistor bipolar elements and the metal-oxide-semiconductor transistor. Author (TAB)

N67-16635*# TRG, Inc., Melville, N. Y.
PHASE I REPORT ON DEVELOPMENT OF A LOW-NOISE 5 MM RECEIVER FRONT END
Nov. 1966 9 p Prepared for JPL
(Contract NAS7-100)
(NASA-CR-81346; R-1523-1) CFSTI: HC $3.00/MF $0.65 CSCL 09A

Consideration is given to amplifier designs for use in a low noise, wideband receiver in the 8.5 (35 Gc) region. Evaluations are summarized for two types of amplifier design, one utilizing a single diode in split waveguide, and the second, a balanced diode with the bias applied through the coaxial idler circuit. Photographs and schematic diagrams of the equipment under development are included. A.G.O.

N67-16666*# Emerson Electric Co., St. Louis, Mo.
THEORETICAL AND EXPERIMENTAL RESEARCH ON DIGITAL ADAPTIVE CONTROL SYSTEM Final Report, 26 May 1965–25 May 1966
John Zaborszky, R. G. Marsh, R. E. Janitch, M. R. Chidambara, and E. E. Buder Washington, NASA, Jan. 1967 325 p refs
(Contract NAS1-5127)
(NASA-CR-669) CFSTI: HC $3.00/MF $0.65 CSCL 09C

A new digital adaptive control system is developed for the effective control of a priori unknown plants. A flyable digital computer of conventional capabilities is the central control agent. The primary control criterion is the minimization of a weighted norm of the output state vector predicted one control interval into the future. Methods appropriate to linear stationary, linear nonstationary, and non-linear plant classes are derived and tested by simulation. Three alternate methods for the representation of unknown linear stationary plants are investigated. More than 1500 control efficacy simulations of a representative plant spectrum through order nine are analyzed. A primary conclusion is that plant representation based on linear interpolation over measured prior responses is of widest applicability. Two alternate methods for interpolation representation of nonstationary linear plants are investigated. Periodic updating of a linear interpolation representation is recommended on the basis of low order simulatory results. Non-linear plant representations by second order Volterra series and by interpolation over quadratic forms are developed and compared. Control of several non-linear plants treated as linear is experimentally demonstrated. An analytic basis for start-up based on the method of matrix pseudo-inversion is determined. Performance criteria and learning procedures are postulated. Author

N67-16685*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
MILLIMETER-WAVE GENERATION WITH ELECTRON-BEAM DEVICES. A CRITICAL SURVEY OF THE STATE OF THE ART
Bernhard Kulke Washington, NASA, Feb. 1967 38 p refs
(NASA-TN-D-3727) CFSTI: HC $3.00/MF $0.65 CSCL 09A

While the state of the art in millimeter-wave generation is still dominated by linear-beam tubes of conventional design, further technological development of these devices faces increasingly difficult fabrication problems. These problems are avoided in another class of devices where a periodically deformed beam is made to yield energy to the electric fields supported by a smooth wave guide. Periodic-beam tubes, such as the cyclotron maser, have already equalled or surpassed the power versus frequency frontier of periodic-circuit devices, and the prospects for further development are very good. Author

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N67-15708*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ADVANCED SCAN PLATFORM
P. Presser *In its* Space Programs Sum. No. 37-41, Vol. IV 31 Oct. 1966 p 32–37 ref (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

This report presents the conclusion of the analytical effort expended and the start of hardware mechanization of the advanced scan platform. This study was concerned with linear and non-linear sensor representation and open- and closed-loop actuation. The investigation resulted in the following conclusions: (1) No shaping, smoothing or other computation is required in the scan platform electronics; sufficient smoothing is provided by the actuator. (2) System performance is better without position feedback around the actuator. A system was designed, and some hardware was tested. Scan platform drive electronics development continues. Author

N67-16061*# Pennsylvania State Univ., University Park. Coll. of Engineering.
SYSTEMS AND CONTROLS LABORATORY Research Report
Oct. 1966 44 p refs
(Grant NGR-39-009-023)
(NASA-CR-80923; RR-4) CFSTI: HC $3.00/MF $0.65 CSCL 09C

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10. SIGNAL NOISE IN FLUID AMPLIFIERS J. C. Tamulis p 15-25 (See N67-16071 06-03)

N67-16066*# Pennsylvania State Univ., University Park. Coll. of Engineering.
NONLINEAR SYSTEM EVALUATION BY OBSERVING EIGENVALUE MOTION
S. A. Steele *In its* Systems and Controls Lab. Oct. 1966 p 5–7 (See N67-16061 06-10) CFSTI: HC $3.00/MF $0.65

Consideration is given to determining how much the eigenvalues of the pseudo-characteristic equation of a nonlinear system can vary during transient response and still give approximate but useful information in the analysis. Determination of whether a given nonlinear system response will be oscillatory or aperiodic has been accomplished for second order systems by observing root excursions. The extension of this root excursion method to higher order problems is treated. Emphasis is on higher order systems such as fourth and seventh. R.N.A.

N67-16067*# Pennsylvania State Univ., University Park. Coll. of Engineering.
APPLICATION OF SWITCHING THEORY TO CONTROL SYSTEMS
S. A. Steele *In its* Systems and Controls Lab. Oct. 1966 p 7–10 (See N67-16061 06-10) CFSTI: HC $3.00/MF $0.65

Many of the fundamental techniques used in the application of switching theory to large complex systems such as digital computers are not convenient for use in the design of control systems. Techniques are described which were developed to simplify the use of switching theory in this kind of problem. The procedure may be used with any switching system. Author

N67-16068*# Pennsylvania State Univ., University Park. Coll. of Engineering.
PERFORMANCE OF THIRD ORDER NONLINEAR CONTROL SYSTEMS
R. Wasta *In its* Systems and Controls Lab. Oct. 1966 p 11–14 (See N67-16061 06-10) CFSTI: HC $3.00/MF $0.65

A method of predicting the step response of control systems described by third order nonlinear differential equations is examined. The nonlinearities are specified mainly as being smooth and not a function of the derivatives of the dependent variable. The method is based on the construction of a root excursion plot which is the locus in a root versus dependent variable plane of the roots of a nonlinear characteristic equation. Comments are made on the various possible shapes of third-order root excursion plots and the step response of the system is related to each particular shape. In particular, it is shown that for certain third-order root excursion plots, it is possible to predict the exact value of system gain or step amplitude which will yield the fastest possible no-overshoot response. Advantages of the method are mainly that the number and location of the nonlinearities are not limited. The prediction of the response is not restricted to a small range immediately around an equilibrium point. A possible extension of the method to higher order nonlinear systems is demonstrated by a fourth-order example. Author

N67-16099# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STUDYING REFLECTING PROPERTIES OF CERTAIN SYSTEMS, HAVING A PERIODIC STRUCTURE
A. A. Semenov, D. K. Kvavadze et al 12 Apr. 1966 17 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. Mat., Mekhan., Astron., Fiz. i Khim. (Moscow), v. 13, no. 1, 1958 p 107–114
(FTD-TT-65-1273; TT-66-62508; AD-640972) CFSTI: HC $3.00/MF $0.65

Translation of Russian research: Studying reflecting properties of certain systems, having a periodic structure. Author (TAB)

N67-16178# RAND Corp., Santa Monica, Calif.
A METHOD FOR CONSTRUCTING CIRCUIT CODES
Victor Klee Oct. 1966 26 p refs
(Contract AF 49(638)-1700; Grant NSF GP-3579; Proj. RAND)
(RM-5112-PR; AD-641187) CFSTI: HC $3.00/MF $0.65

A d-dimensional circuit code of spread s is a simple circuit Q in the graph of the d-dimensional cube (0, 1)d such that any two vertices of Q differing in exactly r coordinates, with $r < s$, can be joined by a path formed from r edges of Q. Such codes are designed to introduce error detection into certain analog-to-digital conversion systems. Longer codes correspond to increased accuracy in determining the maxmum length C(d, s) of d-dimensional circuit codes of spread s. This study contributes to the problem for even values of s by describing a method for combining a code of spread s with a suitably related code of spread s - 1 so as to produce a longer code of spread s. Author (TAB)

N67-16203# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
COMPARISON OF DIGITAL AND ANALOG MECHANIZATIONS OF A TRIPLE-REDUNDANT, SELF-ADAPTIVE FLIGHT CONTROL SYSTEM
Kenneth Elmer Schultz (M.S. Thesis) Jun. 1966 105 p refs
(GGC/EE/66-17; AD-639697) CFSTI: HC $3.00/MF $0.65

As a result of research performed for the Air Force, two laboratory models of a single-axis, triple-redundant, self-adaptive flight control system were constructed. Both models demonstrate

extensive use of integrated circuits; but one system employs analog circuitry, while the other is essentially a digital-differential-analyzer. An objective system comparison is achieved with an exponentially weighted figure of merit incorporating numerical measures of system effectiveness with respect to seven comparison criteria: complexity, cost, performance, power, reliability, volume, and weight. The unique trisafe analog redundancy method is the primary reason for the overall superiority of the analog system. Author (TAB)

N67-16332# Stanford Univ., Calif.
INVESTIGATION OF NONLINEAR CONTROL SYSTEMS. PART 7: STATISTICAL TRENDS IN CONTROL THEORY
Nicholas Minorsky Washington, Office of Naval Res., Mar. 1966 280 p
(Contract N62558-2167)
(AD-641261) CFSTI: HC $3.00/MF $0.65

This report presents a review of the general scope of efforts and results on the statistical or non-deterministic aspects of control theory. Emphasis is placed on reporting the results for nonlinear control systems and on reviewing the Russian work in this area. The first six chapters reproduce in an abridged manner the principal topics of Pougacev's book, "Theory of Random Functions," Moscow, 1962, omitting all material that is not directly connected with control theory. The remainder of the report surveys those aspects of statistical nonlinear control theory which are important for engineering applications. A section deals with the problem of a random disturbance acting on a relay oscillating periodically. A number of problems associated with extremal systems are considered in the last chapter. This is presented in the spirit of an engineering synthesis rather than from a general point of view. Author (TAB)

N67-16379# Illinois Univ., Urbana. Coordinated Science Lab.
THE EXISTENCE AND GENERATION OF A HAMILTON CIRCUIT IN A TREE GRAPH
Takahiko Kamae Sep. 1966 45 p refs
(Contract DA-28-043-AMC-00073(E))
(R-319; AD-640542) CFSTI: HC $3.00/MF $0.65

The existence of a Hamilton circuit in a tree graph was first proved by R. L. Cummins in his Ph. D. thesis at the University of Illinois. However, the proof involves complicated procedures, and it is hard to apply it to the generation of all the trees in a given graph. The new proof, which is straightforward and concise, is given in this paper. This proof is constructive and applicable to the generation of all the trees in a given graph. A general procedure for obtaining a Hamilton circuit in a tree graph is shown. By applying this procedure, all the trees in a graph with 5 vertices and 8 edges are generated in an example. The procedure is of recursive nature and hence suitable for computation by a digital computer. Author (TAB)

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N67-16362# Royal Armament Research and Development Establishment, Woolwich (England).
FLUID DYNAMICS ASPECTS OF THE INTERNAL BALLISTICS OF GUNS
J. B. Goode and D. E. Weald *In* AGARD The Fluid Dyn. Aspects of Ballistics 1966 p 1–12 refs (See N67-15361 06-12)
CFSTI: HC $3.00/MF $0.65

There are two main fluid dynamics aspects of the internal ballistics of guns. These are the longitudinal flow of the propellant gases in the bore, and the pressure and shock waves which may occur. The longitudinal flow is characterized by a pressure gradient associated with the name of Legrange. Discrepancies between experiment and theory are probably due to the obstruction of the propellant grains to the gas flow. The localized nature of ignition tends to set up pressure waves which can be amplified by passing over burning propellant, and which may develop into shock waves. Other aspects are the gas flow out of the barrel after the ejection of the projectile, heat transfer from the gases to the barrel, and recoilless guns. Author

N67-16364# Institut Franco-Allemand de Recherches, St. Louis (France).
DETERMINATION OF THE MOTION OF A PROJECTILE WITHIN THE BORE OF A 20 MM GUN [DETERMINATION DU MOUVEMENT DU PROJECTILE DANS LE TUBE D'UN CANON DE 20 MM]
G. Krauth, H. Lukanow, G. Schultze, and K. Zimmerman *In* AGARD The Fluid Dyn. Aspects of Ballistics 1966 p 37–47 refs In FRENCH; ENGLISH summary (See N67-15361 06-12) CFSTI: HC $3.00/MF $0.65

The motion of a projectile within the smooth bore of a 20 mm gun is analyzed with a Doppler effect radar. For this purpose, microwaves of two different wave-lengths (Q and X bands) are used. The location in time and space of such measurements is checked by means of flash radiography. The motion of the projectile can be calculated owing to simultaneous gas pressure measurements. Integration is carried out according to the conventional internal ballistics method. Results obtained through the Doopler method are compared with those calculated on the basis of the gas pressure variation curve. The correlation between these two types of results is sufficiently satisfactory from the practical standpoint. Author

N67-16365# Computing Devices of Canada, Ltd., Ottawa (Ontario).
INTERIOR BALLISTICS CALCULATION SYSTEMS FOR LIGHT GAS GUNS AND CONVENTIONAL GUNS
J. R. B. Murphy, L. K. Badhwar, and G. A. Lavoie *In* AGARD The Fluid Dyn. Aspects of Ballistics 1966 p 49–78 refs Sponsored by the Defence Res. Board of Can. (See N67-15361 06-12) CFSTI: HC $3.00/MF $0.65

Numerical integration methods have been applied to calculate the fluid dynamics of two stage light gas guns and solid propellant conventional guns. A description of this work and a brief review of other calculation systems is given. The systems developed use an Eulerian frame of reference, which overcomes sources of error in Lagrangian methods. Gas gun computations are compared with experiment and with another numerical method. Stationary and moving propellant charge are considered in the case of the conventional gun and results are compared with very high performance firings. Comments are made regarding possible improvements to and limitations of numerical methods. Author

N67-16366# Royal Armament Research and Development Establishment, Fort Halstead (England).
MODEL EXPERIMENTS ON MUZZLE BRAKES

F. Smith. *In* AGARD The Fluid Dyn. Aspects of Ballistics 1966 p 79–98 refs (See N67-15361 08-12) CFSTI: HC $3.00/MF $0.65

Descriptions are given of model experiments using steady flow. A 7.62 mm rifle was used to substantiate the use of steady flow techniques. A detailed theoretical model for the flow around muzzle brake surfaces is considered, using the available information on free jets. This model fits the experimental results well and could be used to extend the numerous model test results. Author

N67-15361# Ballistic Research Labs., Aberdeen Proving Ground, Md.
REVIEW OF THE HIGH ALTITUDE RESEARCH PROGRAM (HARP)
C. H. Murphy and G. V. Bull (McGill Univ.) *In* AGARD The Fluid Dyn. Aspects of Ballistics 1966 p 403–437 refs Prepared jointly with McGill Univ. (See N67-15361 08-12) CFSTI: HC $3.00/MF $0.65

Project HARP (High Altitude Research Program) is directed toward the use of guns for scientific probing of the upper atmosphere. The attractive features are the basic economy of such a system and the high inherent accuracy of guns for placement at altitude as well as accuracy in ground impact. The basic liability lies in the very high accelerations experienced by gun-launched payloads. The guns vary in size from 5 in. and 7 in. extended guns on mobile mounts to relatively fixed 16 in. guns. Altitude performance varies from 20 lb five-inch projectiles to 240,000 ft to 185 lb 16-in. projectiles to 470,000 ft. Scientific results to data are primarily wind profiles measured by radar chaff, aluminized balloons and parachutes, and tri-methyl-aluminum trails, although a number of successful 250 mc and 1750 mc telemetry flights have been made. Sun sensors, magnetometers, and temperature sensors have been flown and an electron density sensor was fired. Author

N67-15701*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37–41, VOLUME IV FOR THE PERIOD AUGUST 1 TO SEPTEMBER 30, 1966. SUPPORTING RESEARCH AND ADVANCED DEVELOPMENT
31 Oct. 1966 341 p refs
(Contract NAS7-100)
(NASA-CR-81201; JPL-SPS-37-41, Vol. IV) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Summary data are presented on research conducted in the areas of systems analysis, environmental requirements, guidance and control, materials, applied mechanics, aerodynamic facilities, propulsion, space sciences, telecommunications, and Venus capsule science. For individual abstracts, see N67-15702 through N67-15764.

N67-15716*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
WIND TUNNELS
B. Walker, P. Jaffe, R. Weaver, and C. Klose *In its* Space Programs Sum. No. 37–41, Vol. IV 31 Oct. 1966 p 65–72 (See N67-15701 08-11) CFSTI: HC $3.00/MF $0.65

Summary data are presented on tests conducted in the 20 in. supersonic wind tunnel to determine (1) the static stability characteristics of various fin configurations in the presence of a missile-like body; and (2) the aerodynamic drag characteristics of a blunt body in a retrorocket exhaust plume. Equations are also formulated to compute the angle-of-attack envelope as a function of the mass distribution parameter. In efforts to reconstruct a density profile for an unknown atmosphere, consideration is being given to an accelerometer package. Using time versus acceleration along the flight path for 90° entry angles, density versus time can be computed using the classical F = MA equation. Using both the 3 and 6 degrees of freedom computer programs to generate the acceleration versus time data, variations of the resulting equations were tried; an assessment of each is given. Examples are included to illustrate the possibility of using numerical integration. M.G.J.

N67-15717*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
HYPERVELOCITY LABORATORY
F. Livingston, G. Stickford, and J. Williard *In its* Space Programs Sum. No. 37–41, Vol. IV 31 Oct. 1966 p 72–82 refs (See N67-15701 08-11) CFSTI: HC $3.00/MF $0.65

Pitot pressure tests in a 43 in. shock tunnel were conducted using nitrogen as the driven gas. The nozzle exit vertical flow distribution is plotted, and results show that the pitot pressure ratio varies smoothly from a value of approximately 4×10^{-4} on the centerline to approximately 8×10^{-4} at a location 14 in. above and below the centerline. The Mach number distribution corresponds to the measured pitot pressure data for equilibrium nitrogen. Methods of measuring the aerodynamic heating to models in hypersonic shock tunnels are also discussed, with resistance thermometer gauge techniques used. Thin film heat transfer gauge oscillograms are included, along with figures depicting the temperature and heat transfer rate time history. The performance characteristics of a 12 in. diameter free piston shock tube are evaluated; a schematic is presented. Data are given on shock speed, convective heat transfer, and pressure measurements. M.G.J.

N67-15725*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
STERILIZATION STUDIES
S. H. Kalfayan, B. A. Campbell, and J. K. Hoffman *In its* Space Programs Sum. No. 37–41, Vol. IV 31 Oct. 1966 p 115–117 refs (See N67-15701 08-11) CFSTI: HC $3.00/MF $0.65

Cited are the completion of a study on the effects of thermal sterilization on the REL tape recorder, and the development of an automatic ethylene oxide decontamination system. S.C.W.

N67-15772# Thompson (John I.) and Co., Inc., Washington, D. C.
DESIGN AND DEVELOPMENT OF AN AIRPORT RUNWAY SURFACE TRACTION MEASURING DEVICE Final Report
W. E. Meyer, H. W. Kummer, and F. J. Lynch Jan. 1966 46 p refs
(Contract FA-WA-4236)
(FAA-ADS-55)

An airport runway traction measuring device, the surface slip resistance (SSR) tester, was designed and built. The SSR tester can measure brake slip resistance of airport runways at wheel slip ratios from 0 to 100% and at speeds up to 80 mph. The SSR tester was designed to simulate the performance of full-scale aircraft tires. The tread configuration of the test tire enables simulation by a relatively small test device. Selection of test tire and tester parameters are discussed. Design features, including regenerative braking system which permits the stepless variation of the test wheel slip, are described. Development status, vehicle use, and potential improvements are discussed. Author

N67-15795*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
WING TUNNELS
J. T. Welton, B. Walker, W. R. Kerr, W. J. Marko and E. R. Bate, Jr. *In its* Space Programs Sum. No. 37–40, Vol. 4 31 Aug. 1966 p 41–45 (See N67-15781 08-34) CFSTI: HC $3.00/MF $0.65

The procedures used in several wind tunnel tests are briefly described. These included: (1) Detailed flow measurements were made in the near wake of a slender two-dimensional wedge with injection of gaseous nitrogen from the base. Tests were conducted in the 20-in. supersonic wind tunnel at a Mach number of 4.0, and a Reynolds number per inch of about 0.25×10^5. The data show that small rates of gaseous nitrogen injected from the base of the model can cause significant changes to the wake structure. The wake shock is shifted and greatly weakened, and the viscous wake bucket is widened. (2) A series of configurations based on a 60° (half-angle) blunted cone were tested in the 2×2 ft. transonic wind tunnel over a Mach number range from 0.6 to 1.3, at Reynolds numbers of 1×10^6/in. and 0.3×10^6/in. The models tested are depicted, and a standardized system of configuration

notation is tabulated. (3) The hypersonic wind tunnel's auxiliary flow channel was used for measurement of the internal pressure distribution of a 15° conical pintle nozzle with an exit Mach number of 4.5. The test set-up and experimental conditions are outlined. M.G.J.

N67-15806*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
AN AUTOMATIC ETHYLENE OXIDE DECONTAMINATION SYSTEM
R. H. Silver and S. H. Kalfayan *In its* Space Programs Sum. No. 37-40, Vol. 4 31 Aug. 1966 p 103-107 refs (See N67-15781 06-34) CFSTI: HC $3.00/MF $0.65

Design and construction details are given on the system which is completely automated to sequence the decontamination of test samples of polymeric products through six or more identical, controlled cycles, each composed of four separate phases. The specified time, temperature, and relative humidity are manually preset and are then automatically maintained for each phase of each cycle. A commercially available gas sterilizer served as the basic decontamination chamber; this was implemented by the addition of such components and accessories as an integral vacuum and recirculating pump, humidity detection and control apparatus, master cycle timer-programmer, pressure regulators, pressure gauges, solenoid valves, and a flow meter. The dependence of ethylene oxide concentration on temperature and pressure is plotted, and a schematic of the apparatus is included. M.G.J.

N67-15924*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FACILITY CONSTRUCTION AND EQUIPMENT INSTALLATION
J. Orbison *In its* Space Programs Sum. No. 37-42, Vol. III 30 Nov. 1966 p 89-90 (See N67-15901 06-07) CFSTI: HC $3.00/MF $0.65

Progress is reported on the construction and equipment installation at the Pioneer, Echo, Mars, and Venus Deep Space Stations. R.N.A.

N67-15983*# TRW System., Cocoa Beach, Fla.
TOP MANAGEMENT RESPONSIBILITIES, PART II
L. T. Dombras *In its* Explosive Safety Executive Lecture Ser. Jun. 1965 12 p (See N67-15981 06-34) CFSTI: HC $3.00/MF $0.65

The purpose and objectives of the Mission 70 program are reviewed, and occupational accident rates are discussed. The results of various industrial accident programs are reported, and the safety program at Kennedy Space Center (KSC) is compared with those of industry. The responsibility, authority, and functions of the safety office are covered, and the duties of the safety personnel are reviewed. It is pointed out that top management's responsibilities include approving, sanctioning, and supporting the safety office as well as assisting in safety programs, educational activities, and training programs. The responsibilities of NASA headquarters and the policies of the NASA safety accident prevention program are discussed, and it is stated that the development of a safety accident prevention program in accordance with NASA instructions is the responsibility of KSC. Safety program interfaces with contractors, NASA tenant organizations, internal KSC groups, and the Department of Defense are also considered. A supervisor's check list is included, and data are given on some disasters involving propellants and/or explosives. L.E.W.

N67-16041*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
GROUND TEST FACILITIES FOR AIRCRAFT AIRBREATHING PROPULSION SYSTEM DEVELOPMENT
John R. Esterly Washington, NASA, 1967 55 p refs Presented at the Univ. of Tenn. Space Inst., Tullahoma, Tenn., 31 Jan.-10 Feb. 1967
(NASA-TM-X-52224) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The types of propulsion system facilities required for the development and evaluation of advanced airbreathing engines are briefly considered. Among the propulsion systems mentioned are the turbojet, the reciprocating engine, the turboprop and the ram jet engine. Some typical problem areas indicated are: test simulation of pressure ratio, temperature ratio, and Mach number for selected conditions; altitude operating and ignition characteristics; performance and operational aspects of afterburner development; compressor inlet flow distortion; engine dynamics and controls; and, inlet pressure and temperature transients. Performance variables and Reynolds number index are generalized, and some ground test facility types listed. R.L.I.

N67-16120# Naval Ordnance Lab., White Oak, Md.
LIQUID IMPACT SIMULATOR
Mark P. Scher 17 Jun. 1966 36 p refs
(NOLTR-66-181; AD-641139) CFSTI: HC $3.00/MF $0.65

The liquid impact simulator is capable of shooting single jets of water of diameters varying from .020 inch to .100 inch at speeds up to 3000 feet per second. Minor adaptations of the apparatus could produce even higher velocity jets. These liquid jets are capable of pitting metal blocks, puncturing thin sheet metal, or cracking crystals. By varying the target position, the impulse loading rate can be altered. Photographs of jet behavior can be easily obtained. The speeds and masses of the water jets are comparable to those encountered in projectile flights through rain. However, jet diameters are smaller than those of raindrops with corresponding masses. Hence it is likely that longer and higher pressures are applied by the simulator jets. More knowledge of the mechanism of rain impact is necessary for a more accurate simulation. Author (TAB)

N67-16188# Controls for Radiation, Inc., Cambridge, Mass.
OPERATION, MAINTENANCE AND DOSIMETRY ON THE AFCRL LINEAR ACCELERATOR, AND RADIATION EFFECTS ON SILICON AND INSULATORS Final Report, Jun. 15, 1965-Aug. 15, 1966
Sumner Mayburg and James A. Wall 15 Aug. 1966 73 p refs
(Contract AF 19(628)-5214)
(AFCRL-66-681; AD-642415) CFSTI: HC $3.00/MF $0.65

The operation, maintenance, modifications and addition of instrumentation to the AFCRL linear accelerator during the contract period are discussed. Preliminary work on the dosimetry of the linac electron beam and x-rays is described. A National Bureau of Standards P-2 chamber, a Victoreen r-meter in a lucite equilibrium shell, and a prototype carbon calorimeter were tested for the x-ray dosimetry. The trapping of electrons in an insulator is calculated both during and after a radiation pulse. It is found that for very high and narrow radiation pulses the number of trapped electrons is proportional to the logarithm of the total dose while for low-wide radiation pulses the number of trapped electrons is proportional to the total dose. A simple expression is derived for the conductivity produced in an insulator because of the trapping of electrons. This conductivity decays with the time constant for emission of electrons from the traps. Author (TAB)

N67-16193# Ballistic Research Labs., Aberdeen Proving Ground, Md.
SEVEN-INCH HARP GUN-LAUNCHED VERTICAL PROBE SYSTEM: INITIAL DEVELOPMENT
Eugene D. Boyer and Leonard C. MacAllister Jul. 1966 70 p refs
(BRL-MR-1770; AD-640825) CFSTI: HC $3.00/MF $0.65

The description of an upper atmosphere sounding system, based on a modified 175 mm gun, is given. The 175 mm gun tube is extended and smooth bored, and a T76 mount, modified to permit vertical fire is utilized. The gun is used to launch subcaliber, fin-stabilized, center-saboted projectiles. During initial tests, prototype projectile with a paylod volume of fifty cubic

inches attained a maximum altitude of 260,000 feet. A smaller version of the projectile, with a potential payload volume of about fifteen cubic inches reached an altitude of 330,000 feet.
Author (TAB)

N67-16222# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
PRESSURIZED ELECTROSTATIC ACCELERATOR LECH [ELEKTROSTATICHESKII USKORITEL' POD DVALENIEM "LEKH"]
L. Bobrowski, Z. Wilhelmi, E. Gorski, A. Marcinkowski, A. Soltan et al *In its* Nukleonika, Vol. VIII 1966 p 1–27 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The accelerator has been constructed and put into service in the (I-A) Atomic Nucleus Laboratory of the Polish Academy of Sciences Nuclear Research Institute in Warsaw. This vertical generator, of the Van de Graaff type, operating in a pressurized insulating gas medium, is intended in principle for work on the physics of the atomic nucleus [1–6]. The generator operates in air or in a mixture of 70% nitrogen and 30% carbon dioxide. The operating pressure does not exceed 16 atm (for air, 6 atm). The maximum potential obtained without the acceleration tube is 3,000 KV ±5%. When the generator is used with a tube and conic electrodes and with an ion beam it yields a voltage of 2,500 KV.
Author

N67-16232# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
HIGH-FREQUENCY SYSTEM FOR A PROTON ACCELERATOR CONSTRUCTED AS A CAVITY RESONATOR [VYSOKOCHASTOTNAYA SISTEMA PROTONNOGO USKORITELYA V VIDE ODINOCHNOGO REZONATORA]
A. A. Glazov, V. A. Kochkin, L. M. Onishchenko, and E. Shvabe *In* its Nukleonika, Vol. VIII 1966 p 86–97 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

A high-frequency system for a proton accelerator has been built as a toroidal resonator with a high-frequency voltage of 1 MV between the segments. The results of calculations are given for the fundamental frequency and the field distribution in the toroidal resonator. The operation of the oscillator in whose circuit the resonator has been placed is analyzed.
Author

N67-16257# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
LABORATORY GLOVE-BOXES FOR WORK WITH REDIOACTIVE AEROSOLS [LABORATORYJNE KOMORY RAKAWICOWE DO PRAC Z AEROZOLAMI PROMIENIOTWORCZYMI]
A. Siemaszko, M. Nowak, R. Broszkiewicz, and J. Siejka *In its* Nukleonika, Vol. VIII 1966 p 246–249 (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

Prototypes of two types of laboratory glove-boxes have been developed and built for work with radioactive aerosols: for work with the dust of a "dust chamber" and for work with the mists in a "fog chamber". They are designed for every type of scientific research in the realm of removing radioactive contamination caused by beta-radioactive aerosols. The fog chamber, moreover, makes it possible to examine the ability of various filter materials to stop an aerosol. It is noteworthy that series tests (with up to 20 samples of various materials simultaneously) can be carried out in these chambers.
Author

N67-16291# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
WHOLE-BODY COUNTER FOR INTERNAL CONTAMINATION CONTROL
S. Pszona, B. Adamska, and K. Zarnowiecki *In its* Nukleonika, Vol. VIII 1966 p 527–534 Refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

A facility for body radioactivity measurements was built and put in service in the Institute of Nuclear Research. Two scintillation counters NaI(T1) working in a coupled detection system were used as detectors. A calibration *in vivo* for isotope ^{42}K was performed. A calibration with phantom was made for isotopes: ^{198}Au, ^{56}Mn, ^{42}K, ^{24}Na. By comparison of the energy spectra obtained for patient and for phantom it was established that phantom gives a good approximation of absorption and scattering of the radiation in the body. The dependence of the sensitivity on radiation energy was established. The ^{40}K and ^{137}Cs contents in the human body were determined.
Author

N67-16383# California Univ., Berkeley. Lawrence Radiation Lab.
THE OMNITRON: A MULTIPURPOSE ACCELERATOR
Jul. 1966 258 p refs
(Contract W-7405-ENG-48)
(UCRL-16828) CFSTI: HC $3.00/MF $0.65

A proposal is presented for construction of a multipurpose accelerator facility at the Lawrence Radiation Laboratory. The new facility, the Omnitron, will make important extensions in research in the fields of nuclear chemistry, biology and medicine, and medium-energy physics. The Omnitron is made up of two concentric alternating-gradient rings, a rapid-cycling synchrotron and a storage ring, both approximately 120 ft in diameter. The proposal contains research programs, heavy-ion accelerators, general description of the Omnitron, accelerator parameters, magnet system, vacuum system, accelerating system, injection system, extraction system, radiation problems, site and utilities, buildings, experimental areas and technical components, support facilities, construction scheduling, construction-cost estimate, and operation estimates.
NSA

N67-16398# Atomic Energy Commission, New York. Health and Safety Lab.
SPECTRAL ENERGY DISTRIBUTION OF UNFILTERED X-RAYS FROM A 250 kV CONSTANT POTENTIAL MACHINE
Arthur Shambon Aug. 1966 22 p refs
(HASL-179) CFSTI: HC $3.00/MF $0.65

A representation of the energy distribution of four unfiltered beams from a 250 kv constant potential X-ray machine is presented. This representation is consistent with the inverse square law for attenuation of radiation with distance and with the dose rates obtained with a free air ionization chamber. By using a filtered beam and air chamber measurements at two positions in the beam, the location of the X-ray source was accurately established. It was then possible to apply the inverse square law to partial dose rates in 10 kv intervals found analytically at one position and determine attenuated partial dose rates at two other positions of the unfiltered beam. The sum of these partial dose rates was compared with free air chamber measurements of the total dose rate. The total dose rate of the filtered beam was used to calibrate a Victoreen stray radiation chamber. This calibration was compared with one obtained with NBS calibrated sources. All comparisons showed good agreement. A monitoring system was set up to provide a means to correct for small variations in the output of the machine.
Author (NSA)

N67-16464# Naval Ordnance Lab., White Oak, Md.
INSTRUMENTATION, TECHNIQUES AND ANALYSIS USED AT THE NAVAL ORDNANCE LABORATORY FOR THE DETERMINATION OF DYNAMIC DERIVATIVES IN THE WIND TUNNEL
F. J. Regan and J. A. Iandolo Aug. 1966 49 p refs
(NOLTR-66-23; AD-642543) CFSTI: HC $3.00/MF $0.65

A summary is presented on the techniques used for making dynamic stability measurements in wind tunnel facilities. Methods are described for obtaining pitch and roll damping derivatives and Magnus force and moment coefficients. The associated instrumentation which was developed includes an electromagnetic

transducer for measuring angular attitude, air bearings for pitch and roll damping supports, free flight launch systems and a highly sensitive Magnus balance. Author (TAB)

N67-16529# California Univ., Berkeley. Lawrence Radiation Lab.
AUTOMATIC ACCELERATION AND SPEED CONTROL FOR AN ANALYTIC ULTRACENTRIFUGE
Alfred A. Windsor, Thomas H. Rich, Robert E. Doyle, and Frank T. Lindgren 12 Aug. 1966 12 p refs
(Contract W-7405-ENG-48; Grants PHS 5-R01-HE-01882-11; PHS 5-R01-HE-02029-11)
(UCRL-16982) CFSTI: HC $3.00/MF $0.65

A complete profile of automatic acceleration is established with an electronic speed-control system. Motor current is controlled by a Sola (resonant transformer) resonant current source during acceleration; when the rotor reaches full speed the Sola saturates, forming a constant-voltage regulator. As full speed is approached, a closed-loop system is introduced which compares the frequency of a magnetic-gear-tooth counter to a reference circuit and then applies the error as voltage increments to the drive motor. To evaluate performance, a computer program was developed to compare manual control with the automated system. Results indicate greater accuracy in the automated system for the integrated $\omega^2 dt$ during the acceleration phase of ultracentrifuge operation, and extremely stable and accurate control of final speed (10 ppm). Author (NSA)

N67-16546*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DIGITIZED SPARK CHAMBER FOR SPACE SCIENCE EXPERIMENTS
R. W. Ross, C. H. Ehrmann, C. E. Fichtel, and D. A. Kniffen Nov. 1966 16 p refs
(NASA-TM-X-55643; X-611-66-536) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A digitized spark chamber has been developed for gamma-ray and charged particle experiments on balloons and satellites. The spark chamber is assembled from modular units, which are stacked to the desired number of levels. Each module consists of parallel spark planes formed from two orthogonal wire grids. Memory cores, strung on the wires of both grids, record the X–Y coordinate of the spark. Factors affecting the operating characteristics of these modules are discussed. A gamma-ray detector of 32 module levels has been assembled and balloon-flown in a search for cosmic gammaWray point sources. The construction of this detector is described and its performance briefly discussed. Author

N67-16595# General Electric Co., Philadelphia, Pa. Missile and Space Div.
MEASURING TECHNIQUES APPLIED IN DETERMINING THE PERFORMANCE OF AN MHD AUGMENTED SHOCK TUNNEL
Clarence J. Harris, John R. Mallin, and David A. Rogers Oct. 1966 31 p refs Presented at the 2d Intern. Congr. on Instrumentation in Aerospace Simulation Facilities, Stanford, Calif., Aug. 1966
(Contracts AF 40(600)-1091; AF 40(600)-1161)
(R66SD53; AD-641131) CFSTI: HC $3.00/MF $0.65

The determination of the detailed performance of an MHD augmented high enthalpy shock tunnel required the simultaneous measurement of a large number of aerodynamic, electrical, and electromagnetic parameters in a test time interval of the order of several hundred microseconds. An extensive measuring system was set-up, evaluated and in now being used to acquire facility performance data. This paper describes this measuring system, discusses the modifications and adaptations applied to make the various components of the system operable and compatible, and gives illustrative examples of the performance of the system. TAB

N67-16696* Stanford Research Inst., Menlo Park, Calif.
POLYMERS FOR SPACECRAFT HARDWARE: TEST EQUIPMENT DESIGN, PART II Interim Report, Mar.–Dec. 1966
R. Harrington and H. Maxwell 9 Dec. 1966 101 p Prepared for JPL
(Contracts NAS7-100; JPL-950745)
(NASA-CR-81381; IR-3, Pt. II) CFSTI: HC $3.00/MF $0.65 CSCL 14B

Complete design drawings are presented for a volatile condensable material (VCM) apparatus. The micro-VCM apparatus is a multiple-unit (24 samples) designed for screening all kinds of polymeric materials in a simulated spacecraft environment. Vacuum-weight-loss and VCM are determined concurrently. The micro-VCM apparatus consists of two heater units, and a common cooling unit for the VCM collector plates. Samples are contained in individual bored-out compartments in a solid copper block, which are covered by copper discs sealed with Teflon O-rings. In addition to the design drawings, detailed instructions for performing the micro-VCM determination are included. G.P.

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N67-15361# Advisory Group for Aerospace Research and Development, Paris (France).
THE FLUID DYNAMIC ASPECTS OF BALLISTICS
1966 473 p refs In FRENCH and ENGLISH Proc. of the AGARD Specialists Meeting on the Fluid Dynamic Aspects of Ballistics, Mulhouse, France, 5–8 Sep. 1966
(AGARD-CP-10) CFSTI: HC $3.00/MF $0.65

Papers on internal ballistics, intermediate ballistics, liquid filled shell, projectile shape, trajectories, stability, base pressure, bomb ballistics, and ballistic measurements are presented. For individual titles see N67-15362–N67-15382.

N67-15363# Ballistic Research Labs., Aberdeen Proving Ground, Md.
FLUID DYNAMICS OF BULK-LOADED LIQUID PROPELLANT GUNS
Richard H. Corner *In* AGARD The Fluid Dyn. Aspects of Ballistics 1966 p 13–36 refs (See N67-15361 06-12) CFSTI: HC $3.00/MF $0.65

The extent theoretical and experimental work on the instabilities occuring at the interface between two fluids when subjected to acceleration or velocity fields (the so-called Taylor and Helmholtz instabilities) as they pertain to the problem of the interior ballistics of liquid propellant guns, has been reviewed. The relation of these instabilities to the problem of the penetration and break-up of the liquid charge by the cavities produced by the primer and combustion gases is discussed and related to the observed results derived from numerous carefully controlled firings in well-instrumented guns. On this basis, it is shown possible to account for the observations and derived results in a semi-quantitative way. Finally, an idealized model of the functioning of a liquid propellant gun is presented. Author

N67-15416# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
VISCOUS HYPERSONIC FLOWS OVER POINTED CONES AT LOW REYNOLDS NUMBERS

H. F. Waldron Wright-Patterson AFB, Ohio. ARL. Jun. 1966 49 p refs
(Contract AF 33(615)-1205)
(ARL-66-0111; AD-642437) CFSTI: HC $3.00/MF $0.65

An experimental and analytical study of viscous hypersonic flow over pointed cones with particular emphasis on the viscous-layer regime is presented. Shock tunnel measurements of heat transfer to 5, 10 and 20 degree half-angle cones and of pressure on the 20 degree cone are compared with the predictions of a viscous-inviscid interaction analysis (Probstein and Elliot) including transverse curvature, of a viscous-layer nonslender cone analysis (Cheng) and of an extension of the nonslender cone analysis incorporating effects of slenderness. The large rise in heat transfer predicted by the transverse curvature theory is not observed and close agreement is obtained with the nonslender cone viscous-layer predictions. An extension of the nonslender cone analysis is presented where the effects of cone slenderness are included by a perturbation analysis. The solution of the resulting equations reveals that the net effect of transverse curvature and of other effects associated with cone slenderness is small in the viscous-layer regime for not-too-slender cones. Good agreement of the 10 and the 20 degree cone experimental data is obtained with this extension of the nonslender solution. Author (TAB)

N67-15523*# Purdue Univ., Lafayette, Ind. Heat Transfer Lab.
IMPROVED FLUID DYNAMICS SIMILARITY, ANALYSIS AND VERIFICATION. Annual Report, 29 Jun. 1965–28 Jun. 1966
E. R. F. Winter, R. J. Schoenhals, Roger Griebe, W. J. Leech, Terry Libby et al 25 Aug. 1966 180 p refs
(Contract NAS8-20222)
(NASA-CR-81181; AR-1) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Improved Fluid Dynamics Similarity, Analysis and Verification results are presented for three major areas of study: single phase flow during discharge of liquids, two phase flow in the absence of heat transfer, and fluid flow and energy transport in a confined liquid subjected to heat transfer. Similarity parameters obtained by means of dimensional analysis are given. Analytical results, incorporating the various physical effects of importance, are presented graphically in terms of the similarity parameters obtained. Experimental data are also presented graphically in order to verify the similarity parameters, to indicate the operating ranges for which these parameters are important, and to evaluate the accuracy of the analytical results. Author

N67-15552*# National Aeronautics and Space Administration, Washington, D. C.
COMPARISON OF EXPERIMENTAL DATA AND SEMI-EMPIRICAL CALCULATIONS FOR AN IMCOMPRESSIBLE TURBULENT BOUNDARY LAYER WITH A PRESSURE GRADIENT [SOPOSTAVLENIYE DANNYKH EKSPERIMENTA I POLUEMPIRICHESKOGO RASCHETA DLYA NEZHIMAYEMOGO TURBULENTNOGO POGRANICHNOGO SLOYA S GRADIYENTOM DAVLENIYA]
A. V. Kolesnikov Dec. 1966 11 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), v. 10, no. 4, 1966 p 465–471
(NASA-TT-F-10434) CFSTI: HC $3.00/MF $0.65 CSCL 20D

A comparison is presented of velocity profiles for an incompressible turbulent boundary layer obtained by semiempirical calculations with those obtained by applying universal empirical laws. The existence of a similarity between the velocity distributions in the internal portion of a boundary layer with various Reynolds numbers and the pressure gradients in the external flow is confirmed by the results of semiempirical calculations. It is shown that if a satisfactory approximation is adopted for the shear stress and mixing length, the predicted velocity distributions in the external portion of the layer at a constant pressure practically coincide with the "velocity defect law." The drag law determined for this case, using the semiempirical method, is confirmed by the experimental relation of Folkner, even though rough approximations are used for the shear stress and the mixing length. Author

N67-15661*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
A COMPUTER PROGRAM FOR CALCULATING VELOCITIES AND STREAMLINES FOR TWO-DIMENSIONAL, INCOMPRESSIBLE FLOW IN AXIAL BLADE ROWS
Theodore Katsanis Washington, NASA, Jan. 1967 76 p refs
(NASA-TN-D-3762) CFSTI: HC $3.00/MF $0.65 CSCL 20D

A Fortran computer program was written that gives the solution of the two-dimensional, incompressible, ideal flow problem for an infinite cascade of blades, or equivalently, a two-dimensional, circular cascade of constant radius, as in an axial-flow turbine. The computer program requires only the basic cascade geometry as input. The output includes streamline coordinates, velocity magnitude and direction throughout the passage, and the blade-surface velocities. The method is based on the stream function, with the solution of the simultaneous, linear finite-difference equations being obtained iteratively by using successive overrelaxation, with an estimated optimum overrelaxation factor. This report includes the Fortran computer program that was developed, with a complete explanation of the equations involved, the method of solution, and the calculation of the velocities. A sample problem has been included to illustrate the use of the program, and to show the results that can be obtained. The program results are in good agreement with experimental results at low Mach numbers. It is concluded that reasonable results can be obtained if there is little variation in density. Author

N67-15665*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
EXPERIMENTAL FLOW FIELD AND HEAT-TRANSFER INVESTIGATION OF SEVERAL TENSION SHELL CONFIGURATIONS AT MACH NUMBER OF 8
Robert A. Jones, Dennis M. Bushnell, and James L. Hunt Washington, NASA, Jan. 1967 60 p refs
(NASA-TN-D-3800) CFSTI: HC $3.00/MF $0.65 CSCL 20D

A study to determine the effect of wall-to-total-temperature ratio, Reynolds number, and angle of attack on the formation and extent of boundary layer separation; and the resulting flow fields about certain of these shapes, is reported. Schlieren data were obtained on four preliminary shapes for ranges of free-stream Reynolds numbers based on model base diameter from 0.106×10^6 to 1.36×10^6, wall-to-total-temperature ratios from 0.2 to 0.9, and angles of attack from 0° to 31°. Based on the results for these preliminary configurations, a shape was selected that appeared to have steady flow and high drag for a wide range of conditions. Pressure and heat-transfer distributions were obtained for this improved shape at wall-to-total-temperature ratios of approximately 0.9 and 0.5, respectively, angle of attack from 0° to 20°, and free-stream Reynolds numbers based on base diameter of 0.2×10^6 and 0.5×10^6. The effect of normal shock density ratio on the flow field was investigated for this shape in a small hypersonic facility using CF_4 (tetrafluoromethane) as the test gas. Author

N67-15681*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
BASIC CRITERIA AND DEFINITIONS FOR ZERO FLUID LEAKAGE
Richard S. Weiner 15 Dec. 1966 17 p refs
(Contract NAS7-100)
(NASA-CR-81189; JPL-TR-32-926) CFSTI: HC $3.00/MF $0.65 CSCL 20D

This report defines both liquid and gaseous zero leakage over a pressure range from 1.0 to 0.1 psi, respectively, to 10,000 psi. Graphs are included for clarity and use. The zero liquid leakage graph contains an equivalent gaseous helium test leakage curve. A fluid flow conversion nomograph was constructed from certain

applications of the Poiseuille equation and is offered to help simplify efforts of specification writers and test personnel in obtaining equivalent flow rates between fluids, over a wide range of pressures and temperatures. Discussions of leak test methods and test techniques complete the report. This report is relevant to such current programs as *Mariner* and *Surveyor*. Author

N67-15698*# National Aeronautics and Space Administration, Washington, D. C.
CALCULATION OF A JET AXIS IN A DRIFTING FLOW [RASCHET OSI STRUI V SNOSYASHCHEM POTOKE]
G. S. Shandorov Dec. 1966 7 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Ser. Aviats. Tekh. (Kazan), v. 9, no. 2, 1966 p 100–104
(NASA-TT-F-1063) CFSTI: HC $3.00/MF $0.65 CSCL 20D

The article discusses derivation of a solution for the problem of deflection of a jet which is subject to drift in a uniform unbounded subsonic gas flow. The solution is based on an analysis of forces acting on a jet element and is applicable to a single jet with an originally circular cross section. Author

N67-15743*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ROTATIONAL TEMPERATURE MEASUREMENT IN A FREE JET AND IN A STATIC GAS
H. Ashkenas *In its* Space Programs Sum. No. 37-41, Vol. IV 31 Oct. 1966 p 196–200 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

Rotational temperatures given by a spectrographic examination of the rotational fine structure of the band spectra of electron beam excited nitrogen have been determined for free jet flow conditions. The spectral data were reduced on a reduction scheme based on Muntz' model of the excitation and de-excitation of electron beam excited nitrogen which fits a least squares straight line to the spectral intensity distribution, after making proper temperature dependent modifications to the data. Graphs of the preliminary results indicate disparities which lead to the conclusion that, although the Muntz model gives good results at temperatures greater than or equal to room temperatures, its applications to cases where the temperature is below 200°K results in incorrect data. A.G.O.

N67-15765*# National Aeronautics and Space Administration, Washington, D. C.
OPTIMUM FORMS OF BODIES WITH ASSOCIATED SHOCK WAVES [OPTIMAL'NYYE FORMY TEL S PRISOYEDINENNYMI UDARNYMI VOLNAMI]
A. V. Shipilin Jan. 1967 16 p refs Transl. into ENGLISH from Mekhan. Zhidkosti i Gaza (Moscow), no. 4, 1966 p 9–18
(NASA-TT-F-10672) CFSTI: HC $3.00/MF $0.65 CSCL 20D

The problem is discussed of finding the form of two-dimensional and axisymmetric bodies guaranteeing the minimum wave drag in the supersonic flow of an ideal gas. The solution is sought among those bodies which–when flow passes around them–give rise to associated shock waves. Limitations on the contour of the body are arbitrary: One may pre-assign the dimensions of the body, its volume, area, etc. Similar problems with arbitrary isoperimetric conditions can be solved by a method previously proposed. This method consists of using the exact equations of gas dynamics, describing the flow, as supplementary constraints. Author

N67-15777# Imperial Coll. of Science and Technology, London (England). Dept. of Mechanical Engineering.
THE PREDICTION OF TURBULENT BOUNDARY LAYER DEVELOPMENT IN CONICAL DIFFUSERS
A. D. Carmichael and G. N. Pustintsev Jun. 1966 41 p refs (TWF/TN/15)

Methods of predicting the growth of turbulent boundary layers in conical diffusers using the kinetic energy deficit equation were developed. Three different forms of auxiliary equations were used. Comparison between the measured and predicted results showed that there was fair agreement although there was a tendency to underestimate the predicted momentum thickness and overestimate the predicted shape factor. Author

N67-15844*# Mississippi State Univ., State College. Dept. of Mechanical Engineering.
STUDY OF PRESSURE LOSSES IN TUBING AND FITTINGS Quarterly Progress Report, Dec. 1965–Feb. 1966
C. W. Bouchillon, C. T. Carley, J. E. Corley, and J. McDermit Feb. 1966 27 p refs
(Contract NAS8-11297)
(NASA-CR-81236; QPR-7) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Continuing work in the investigation of pressure losses in tubing and fittings is reported, and details are given on extending the literature review, refining flow systems analysis to gain better agreement between prediction and observation, and studying entrance effects in flexible metal hoses. The computer program to predict the pressure drop in an arbitrary flow system was modified to incorporate pressure drop relations, and an analysis was then performed on a section of the test line to determine its pressure drop characteristics. The major pressure drop was produced by the 1-in. diameter, 10-ft long flexible metal hose. The experimentation conducted to ascertain the accuracy of the predicted pressure drop is described, and results indicated that the predicted and measured pressure drops agreed closely except at very low flowrates. Methods of analyzing flow over a rough surface are reviewed, and test results obtained from the entrance effects test station are discussed. Extensive graphs are included, as well as a flow diagram for the entrance effect program. L.E.W.

N67-15849# Lockheed Missiles and Space Co., Palo Alto, Calif.
VIBRATIONS OF A SUPERSONIC GAS FLOWING IN A FINITE CHANNEL WITH OSCILLATING WALLS
D. A. Derbentsev [1966] 4 p refs Transl. into ENGLISH from Prikl. Mekh., Akad. Nauk Ukr. RSR (Kiev), v. 2, no. 9, 1966 p 124–127 Presented at the Conf. of Young. Researchers of the Mech. Inst. AN UkrSSR, Kiev, 1 Mar. 1966

The pressure on a body surface in a hypersonic gas flow may be computed by the piston theory. However, it is impossible to do this when the flow is within a channel because of the presence of waves reflected from the axis. The purpose of this paper is to determine the pressure on the walls of a cylindrical channel taking account of the influence of the waves reflected from the axis. To do this a tube with an inner radius R_0 and length L in which a gas flows with supersonic velocity u is examined. The gas is flow considered to be potential and isentropic. Author

N67-15885*# Southwest Research Inst., San Antonio, Tex.
THE DYNAMIC BEHAVIOR OF LIQUIDS IN MOVING CONTAINERS: INTRODUCTION
H. Norman Abramson *In its* Dyn. Behavior of Liquids in Moving Containers, 1966 p 1–11 refs (See N67-15884 06-12) GPO: HC $2.75; CFSTI: MF $0.65

A general discussion of the dynamic behavior of liquids in moving containers is presented followed by the more specific case of propellant sloshing in launch vehicles. The various types of propellant tank configurations and the kinds of propellant sloshing are mentioned along with examples of fuel slosh effects on flight dynamics. R.N.A.

N67-15886*# Southwest Research Inst., San Antonio, Tex.
LATERAL SLOSHING IN MOVING CONTAINERS
Sandor Silverman and H. Norman Abramson *In its* Dyn. Behavior of Liquids in Moving Conteiners 1966 p 13–78 refs (See N67-15884 06-12) GPO: HC $2.75; CFSTI: MF $0.65

The characteristics of lateral sloshing behavior, primarily liquid frequencies, mode shapes, and forced response characteristics, for various container configurations are presented in detail. The basic elements of the underlying hydrodynamic theory are given followed by analytical relationships and calculated and experimental data for a wide variety of cases. Only rigid tanks are considered. Author

N67-15887*# Southwest Research Inst., San Antonio, Tex.
NONLINEAR EFFECTS IN LATERAL SLOSHING
H. Norman Abramson, Wen-Hwa Chu, and Franklin T. Dodge *In its* Dyn. Behavior of Liquids in Moving Containers 1966 p 79–103 refs (See N67-15884 08-12) GPO: HC $2.75; CFSTI: MF $0.65

The nonlinear effects rising inherently from particular tank geometries, primarily in the compartmented tank, or as a consequence of large amplitudes of excitation, or from instabilities in the large amplitude motions near resonance (rotational sloshing) are discussed. The first of these may have important implications for design. Author

N67-15888*# Southwest Research Inst., San Antonio, Tex.
DAMPING OF LIQUID MOTIONS AND LATERAL SLOSHING
Sandor Silverman and H. Norman Abramson *In its* Dyn. Behavior of Liquids in Moving Containers 1966 p 105–143 refs (See N67-15884 08-12) GPO: HC $2.75; CFSTI: MF $0.65

A large quantity of experimental data gained primarily from laboratory investigations of damping characteristics in lateral sloshing in rigid tanks is presented. Consideration is given to the simple viscous damping effects in various tanks and to the effectiveness of different types of suppression devices. Such devices take a wide variety of forms, ranging from floating objects and systems which follow the free surface to many types of fixed baffle configurations. Author

N67-15889*# Southwest Research Inst., San Antonio, Tex.
SIMULATION AND EXPERIMENTAL TECHNIQUES. PART I: SIMULATION OF LIQUID SLOSHING
John F. Dalzell *In its* Dyn. Behavior of Liquids in Moving Containers 1966 p 145–169 refs (See N67-15884 08-12) GPO: HC $2.75; CFSTI: MF $0.65

The application of dimensional analysis to simulation and simulation analysis of liquid sloshing are discussed in an attempt to yield some perspective on the extent to which fluid dynamic and fluid structure interaction problems may be simulated. The prognosis for small scale direct simulation of every problem in fuel sloshing is poor, at least not without considerable sophistication of equipment and techniques. Experiments are still needed to determine the practical effect of going out of scale with respect to one parameter or another. The discussion gives many instances, particularly with respect to surface tension and low gravity phenomenon, where the simulation analysis becomes incomplete through the omission of thermodynamic effects. R.N.A.

N67-15890*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL TECHNIQUES AND APPARATUS
George W. Brooks *In* Southwest Res. Inst. Dyn. Behavior of Liquids in Moving Containers 1966 p 170–197 refs (See N67-15884 08-12) GPO: HC $2.75; CFSTI: MF $0.65

The experimental techniques and apparatus developed for research on the dynamics of sloshing propellants are reviewed. The discussion covers small tank construction techniques, tank support and excitation, fluid natural frequencies and mode shapes, damping, sloshing forces, swirl and dome impact slosh, coupling of fluid motions and structural deformations, and coupling of fluid and tank motions. Experiments dealing with damping in cylinders, the two-dimensional damping effectiveness of baffles, and the vibration characteristics of pressurized thin walled circular cyclinders partly filled with liquid are reviewed. Vibration tests of both small and full scale dynamic launch vehicle models are discussed. R.N.A.

N67-15891*# Southwest Research Inst., San Antonio, Tex.
ANALYTICAL REPRESENTATION OF LATERAL SLOSHING BY EQUIVALENT MECHANICAL MODELS
Franklin T. Dodge *In its* Dyn. Behavior of Liquids in Moving Containers 1966 p 199–223 refs (See N67-15884 08-12) GPO: HC $2.75; CFSTI: MF $0.65

Both simple and complex equivalent mechanical models are derived and discussed for use as analytical representations of lateral liquid sloshing. The mechanical model is used to replace the liquid because the equations of motion for point masses and rigid bodies are usually included more readily in the overall transfer function of the tank than for a continuously deformable liquid. It is shown that the liquid cannot be completely replaced by a single body of suitable mass and moment of inertia that is rigidly attached to the tank. Instead, a system of spring masses or pendulums must be included. These oscillating masses are needed to duplicate the oscillating slosh forces arising from the wave action at the free surface. R.N.A.

N67-15898*# Southwest Research Inst., San Antonio, Tex.
LIQUID ROTATION AND VORTEXING DURING DRAINING
Franklin T. Dodge *In its* Dyn. Behavior of Liquids in Moving Containers 1966 p 373–377 refs (See N67-15884 08-12) GPO: HC $2.75; CFSTI: HC $3.00/MF $0.65

Available theories and experimental results on liquid rotation and vortexing are reviewed. The discussion centers on the vortex that forms whenever a tank drains through a small orifice, however, liquid rotation is included, since by its very nature a vortex is accompanied by a substantial amount of swirling liquid motion. The discussion concludes that no existing theory completely explains vortex formation and liquid rotation during draining. In some cases, such as when rotary sloshing and draining occur simultaneously, large roll torques can be exerted on the tank, and the draining flow rate may be substantially decreased. Adequate baffling can ameliorate this situation, and since such suppressors are almost invariably provided to control normal sloshing, vortexing and rotational motions should be adequately controlled in normal cases. R.N.A.

N67-15937# Lockheed Missiles and Space Co., Palo Alto, Calif.
LOCAL SIMILITUDE METHOD FOR A THREE-DIMENSIONAL BOUNDARY LAYER WITH PRESSURE GRADIENT
B. A. Zamlianskii [1966] 7 p refs Transl. into ENGLISH from Izv. Akad Nauk SSSR, Mekhan. (Moscow), no. 4, 1966 p 70–75

The hypersonic boundary layer has a number of singularities, one of which is its relatively weak sensitivity to a negative pressure gradient. This is associated with the presence in the boundary layer of a comparatively cold high density gas near the wall. The method of local similitude using the known Blasius solution for a plate is applied for an approximate description of such flows. Author

N67-15967# Hydronautics, Inc., Laurel, Md.
THE DYNAMIC PRESSURE TRACE AT THE SEA BOTTOM CREATED BY A GROUND EFFECT MACHINE
T. T. Huang and K. K. Wong Feb. 1966 54 p ref
(Contract Nonr-4695(00))
(TR-505-1; AD-641372) CFSTI: HC $3.00/MF $0.65

The theory was derived for the dynamic pressure trace at the sea bottom and the surface waves created by a ground effect machine of rectangular planform moving with constant velocity over quiescent water of finite depth. The numerical results for the dynamic pressure trace at the sea bottom are presented. Because of convergence difficulties, the numerical calculation of the exact

surface wave contour was not completed. However, the convergence characteristics were improved by deforming the path of integration. Further effort is necessary in order to obtain the numerical results for the surface waves. For very shallow water, solutions for both the pressure trace and surface wave contour were obtained. Author (TAB)

N67-16112# David Taylor Model Basin, Washington, D. C.
CALCULATIONS ON THE COLLAPSE OF A SPHERICAL GAS-FILLED CAVITY IN A COMPRESSIBLE LIQUID Final Report
Russel R. Lilliston Aug. 1966 44 p refs
(DTMB-2223; SP-6-0002; AD-641087) CFSTI: HC $3.00/MF $0.65

The paper presents a method for calculation the instantaneous pressure, velocity, acceleration, and radius associated with the collapse of a spherical gas-filled cavity in an infinite compressible liquid. The method is an independent approach which makes use of Hamming's technique to numerically integrate Gilmore's differential equations which describe the collapse. Included is a computer program which will perform the necessary calculation on a IBM 7090/1401 digital computer. It may be inferred that the peak shock wave pressure is significantly reduced by a decrease in ambient pressure, and increase in internal pressure, and/or a variation of the specific heat ratio by proper selection of the gas. Control of the last two parameters can be investigated as a possible means of protecting glass spheres against sympathetic implosion in multiple sphere buoyancy systems. Author (TAB)

N67-16131# Army Missile Command, Huntsville, Ala. Propulsion Lab.
AN INVESTIGATION OF THE RHEOLOGY OF GELS
Joel H. Blatt and Barry D. Allan 22 Aug. 1966 22 p refs
(RK-TR-66-15; AD-641484) CFSTI: HC $3.00/MF $0.65

The report describes work accomplished on the rising sphere rheometer and efforts to develop a standard gel to be used for interlaboratory comparisons both on the rising sphere and on the Brookfield viscometer. The construction details and wiring for the rheometer and an optical method for checking the rate of rise are presented. It was found that the accuracy of the rheometer could be greatly improved by expanding and displaying the output scale on a Leeds and Northrup recorder. Several batches of a standard gel (0.15-percent Carbopol 940 in water) were tried but gave inconsistent results with this rheometer, as well as not giving consistent densities. The results of these tests seem to indicate that Carbopol 940 is not suitable as a component in standard gels, if unsophisticated mixing methods are to be used. In addition, Cabosil (2 concentrations tried), Methocell 90HG-D65 (3 concentrations tried), and Cellosize 5229-JJ were tried with water all mixed by hand shaking. All samples failed to demonstrate reasonable yield values or settled on standing. Author (TAB)

N67-16134# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
THE METHOD OF CHARACTERISTICS FOR THE SUPERSONIC FLOW OF AN IDEAL DISSOCIATING GAS. II: NONEQUILIBRIUM FLOW
F. Edward Ehlers Jul. 1966 113 p refs *Its* Math. Note No. 473
(D1-82-0548; AD-640381) CFSTI: HC $3.00/MF $0.65

A method of characteristics for computing the supersonic, nonequilibrium flow of a reacting and relaxing gas was formulated. The theory was specialized to the ideal dissociating gas of Lighthill and the procedures coded on the IBM 7094. Complete listings of the FORTRAN programs are provided together with instructions as to their use. As examples of the computation techniques, the flows over a wedge and cone were computed and described in detail. For both the wedge and the cone, there developed downstream from the vertex an entropy layer near the wall, a relaxation layer near the shock where the quantities change rapidly, and a near equilibrium layer in between. It was found that it is important to keep the size of the mesh small enough to adequately represent the relaxation layer if satisfactory convergence to the equilibrium state is to be obtained. Author (TAB)

N67-16146# Massachusetts Inst. of Tech., Cambridge. Gas Turbine Lab.
CONDENSATION OF SUPERSATURATED AMMONIA AND WATER VAPOR IN SUPERSONIC NOZZLES, JANUARY–SEPTEMBER 1966
Harry L. Jaeger Sep. 1966 120 p refs
(Contract Nonr-3963(07))
(Rept.-86; AD-641256) CFSTI: HC $3.00/MF $0.65

An experimental investigation of condensation of ammonia and water vapor in supersonic nozzles is presented. Static-pressure data for both substances were obtained on the same apparatus using dried compressed air as the carrier gas. The effect of carrier-air moisture on the results for ammonia was also studied. A comparison between the data and predictions using existing nucleation and drop-growth theories indicated that neither the classical nor revised, so-called gasification, theories were generally applicable. The former agreed with the water data while the latter was in agreement with the data for ammonia. Author (TAB)

N67-16173# National Bureau of Standards, Washington, D. C.
COLLISIONS OF LIQUID DROPS WITH LIQUIDS. SUPPLEMENT I: NEW CRATER DEPTH DATA FOR IMPACTS OF WATERDROPS WITH WATER
Olive G. Engel Wright-Patterson AFB, Ohio, AF Mater. Lab., Jun. 1966 24 p refs
(Contract AF 33(657)-62-385)
(WADD-TR-60-475, Pt. II, I; AD-641302) CFSTI: HC $3.00/MF $0.65

The report is a supplement to WADD TR 60-475, Part II (AD-406 984), Crater Depth In Fluid Impacts. New crater depth data for impacts of waterdrops against water, which were obtained with an improved experimental arrangement, are presented and used to test the theoretical equation that was derived in the earlier report. Author (TAB)

N67-16217# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
ON THE CONVERGENCE AND EXACTNESS OF SOLUTIONS OF THE LAMINAR BOUNDARY EQUATIONS USING THE N-PARAMETER INTEGRAL FORMULATION OF GALERKIN–KANTOROVICH–DORODNITSYN
Howard E. Bethel Jul. 1966 281 p refs
(ARL-66-0090; AD-642239) CFSTI: HC $3.00/MF $0.65

The solution of the incompressible, laminar boundary-layer equations using the N-parameter integral method of Galerkin, Kantorovich and Dorodnitsyn is investigated. This method seeks to obtain an approximate solution of a partial differential equation with given boundary conditions by assuming the solution in functional form so that the boundary conditions for one variable are exactly satisfied. The approximating function is then specialized in such a manner as to obtain approximate satisfaction of the given equation. Solutions are presented for the similar flows and four types of nonsimilar flows: flows with an abrupt change from an initial region of flow to a constant velocity flow, analytically prescribed external flows, experimentally determined external flows, and flows which proceed from a stagnation point to a separation point. These results indicate that the GKD method yields solutions which are uniformly better than classical approximation techniques and are of about the same accuracy as the usual exact numerical solution methods. Author (TAB)

N67-16327# Hydronautics, Inc., Laurel, Md.
FLOW PHENOMENA CAUSED BY THE COLLAPSE OF A MIXED REGION IN A DENSITY-STRATIFIED MEDIUM
Jin Wu Mar. 1966 60 p refs
(Contract Nonr-3688(00))
(TR-231-11; AD-640800) CFSTI: HC $3.00/MF $0.65

Various phenomena are caused by the collapse of a mixed region in a model ocean; these include internal waves propagated in the linear-stratified medium below the thermocline, interfacial waves at the density-discontinuous interface (thermocline) and surface currents at the free surface. Results include the wave and orbital motions produced outside of the collapsing region for a number of different density stratifications. Regular internal waves of progressive oscillatory type propagating along the isopycnic lines can be scaled according to the length scale of the mixed region and the inverse time scale of the linear-stratified medium (Vaisala frequency of the medium). The value of the density jump at the thermocline determines whether the interfacial wave is characterized by the modeled thermocline and is essentially of a shallow water wave type, or is characterized by the lower stratified field and is essentially an internal wave distrubance. A series of divergences or convergences (surface sloshing currents) was observed at free surface; the general pattern of these currents shows that the water particles oscillated sinusoidally with time at each station, and that particles separated by approximately half an interfacial wave length oscillated exactly out of phase. Author (TAB)

N67-16366# Massachusetts Inst. of Tech., Cambridge. Dept. of Aeronautics and Astronautics.
SUPERSONIC STEADY AND UNSTEADY FLOWS OVER SLENDER AXISYMMETRIC BODIES WITH CONTINUOUS OR DISCONTINUOUS SURFACE SLOPES, PART II
Jerzy J. Kacprzynski Oct. 1966 81 p *Its* MIT Fluid Dyn. Res. Lab. Rept.-66-6, Pt. II
(Contract AF 49(638)-1622)
(AFOSR-66-1945; AD-642412) CFSTI: HC $3.00/MF $0.65

The paper contains the second part of an investigation aimed at finding methods for calculating steady and unsteady inviscid flows past slender three-dimensional bodies of general shape, with continuous or discontinuous slope but with continuous cross-sectional area. The report deals with nonlinear flow problems past cones, smooth bodies of arbitrary axisymmetric shape and bodies with discontinuities in slope. The modified method of parametric differentiation is used to solve these problems. Results of numerical calculations are given and compared against results of experiments and results of the method of characteristics. Author (TAB)

N67-16403# ARO, Inc., Arnold Air Force Station, Tenn.
AN EXPERIMENTAL INVESTIGATION OF MIXING HIGH TEMPERATURE AIR WITH AMBIENT BYPASS AIR BY UPSTREAM INJECTION
C. E. Simmons (Arnold Eng. Develop. Center) and J. R. Henson Arnold Eng. Develop. Center, Nov. 1966 146 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-66-146; HD-641712) CFSTI: HC $3.00/MF $0.65

A mixing chamber employing upstream injection of the secondary airflow was designed and tested in conjunction with a Mach 4.0 nozzle. Mixing chamber configurations with total length to maximum diameter ratios of 1.7 and 2.3 were investigated. The mixer was designed for a secondary to primary mass flow ratio of 2.57 and a primary to stilling chamber pressure ratio of 4.78. A uniform temperature profile with not more than 5 percent variation at the exit of the Mach 4.0 nozzle was required. The mixing chamber was experimentally investigated at secondary to primary mass flow ratios of 0.86 to 2.70. The primary mass flow ranged from 0.99 to 1.5 lb/sec at temperatures from 1730 to 2240R, depending upon the heater flow rate. The secondary flow temperature was approximately 470R. Temperature and pressure profiles obtained in the mixing chamber and 0.5 in. downstream of the Mach 4.0 nozzle exit substantiated satisfactory mixer performance. Author (TAB)

N67-16414# Notre Dame Univ., Ind. Dept. of Aero-Space Engineering.
A COMBINED VISUAL AND HOT-WIRE ANEMOMETER INVESTIGATION OF BOUNDARY LAYER TRANSITION Final Report
C. F. Knapp, P. J. Roache, and T. J. Mueller Aug. 1966 101 p refs
(Contract Nonr-1623(17))
(UNDAS-TR-866CK; AD-640907) CFSTI: HC $3.00/MF $0.65

The results of a wind tunnel study of the structure of boundary layer transition on an ogive nose cylinder alined parallel to the flow are presented. Both natural and forced transition in both a zero and an adverse pressure gradient are studied at subsonic speeds by means of the visual (smoke) technique. In the visual technique, both still pictures and high speed (4000 frames per second) motion picture films are used. Natural transition is shown to differ from forced transition (using acoustic excitation to control the wave frequencies) in several aspects. Natural transition is intermittent, while forced transition is continuous. The vortex truss structures tend to be staggered in a thatched pattern in natural transition, but tend to be alined in rows in forced transition. In natural transition, the initially two-dimensional waves break down in sets, simultaneously, whereas in forced transition the individual waves break down successively upon reaching a fixed axial position. An adverse pressure gradient tends to produce a transition structure similar to that of forced transition. It is also shown that sound of a very low frequency can control, rather than eliminate, intermittency. Lastly, the use of a hot wire anemometer probe immersed directly in the smoke flow was shown to be a valuable research tool for the correlation of visual and hot wire anemometer data. Author (TAB)

N67-16463# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
HELE-SHAW SOURCE SINK AND CIRCULATORY FLOW VISUALIZATION
William Harold Boss (M.S. Thesis) Jun. 1966 88 p refs
(GAM/AE/66B-10; AD-642359) CFSTI: HC $3.00/MF $0.65

The experimental study resulted in the visualization of classical sink and source flow combinations in a uniform flow stream. The Hele-Shaw apparatus was used to present two-dimensional displays which were photographed in color. The Hele-Shaw apparatus consists of two matched 20 X 17 inch plates of glass separated by strips of tape between two opposite edges of the glasses. A sheet of water is slowly introduced into one open end of the glasses and flows out the opposite end. The desired patterns of flow were produced by injecting dye streams into the water at the upstream opening and by pumping a contrasting dye in and/or out of the water through holes near the center of one of the glass plates. Pictures were obtained showing the streamlines in a uniform stream of a source, a sink, a sink behind a source (Rankine oval), a sink closely behind a sink (circular cylinder), a row of sinks behind a source (airfoil), and a row of sources between two single sources (engine inlet). A picture simulating potential flow circulation was also acquired. Author (TAB)

N67-16477# Naval Ordnance Lab., White Oak, Md.
THE WATER ENTRY PROBLEM WITH BIBLIOGRAPHY
W. E. Parr 31 Aug. 1966 65 p refs
(NOLTR-66-173; M-65; AD-641176) CFSTI: HC $3.00/MF $0.65

The report is a survey of the water entry problem and its various mathematical formulations. Included are discussions on the incompressible case, the compressible case, the linearized incompressible, the linearized compressible, reflected linearized incompressible, Lagrangian, two-dimensional and axially-symmetric

cases. Also discussed are the source and dipole formulations, calculation of added masses, similar solutions, problems related to water entry, and a note of caution concerning the conservation of mass in an infinite region. Finally, a fairly extensive bibliography is given primarily covering theoretical work on the water entry and related problems. Author (TAB)

N67-16487# Library of Congress, Washington, D. C. Aerospace Technology Div.
POPULATION INVERSION IN ADIABATIC EXPANSION OF A GAS MIXTURE Foreign Scientific and Technical Literature
Simon Kassel 12 Sep. 1966 6 p refs Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz., Ki. Pisma v Redaktsiyu (USSR), v. 3, no. 11, 1966 p 436–439
(ATD-66-115; TT-66-62588; AD-641863) CFSTI: HC $3.00/MF $0.65

The paper shows that adiabatic expansion of certain mixtures of molecular gases gives rise to the condition of population inversion in terms of vibrational levels existing for a certain time. To achieve this the molecules of the mixture should have substantially different vibrational relaxation times and should be capable of exchanging the energy of the vibrational excitation. Author (TAB)

N67-16542*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EFFECT OF REYNOLDS NUMBER ON SLOSH DAMPING BY FLAT RING BAFFLES
Harry Buchanan and Larry Lott 22 Dec. 1966 22 p refs
(NASA-TM-X-53559) CFSTI: HC $3.00/MF $0.65 CSCL 20D

This paper examines the existing slosh data for flat ring baffles to define the effect of Reynolds number on damping. For this purpose, the drag coefficient of the baffle is presented in terms of Reynolds number. Results show that the drag coefficient increases sharply as the Reynolds number approaches zero. This implies that, for very low Reynolds numbers such as those encountered under low g, slosh damping by ring baffles will be significantly increased. Author

N67-16553*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
KINETIC THEORY OF BIMOLECULAR CHEMICAL REACTION, DIFFUSIVE DRAG, AND OTHER PROCESSES IN A GAS MIXTURE
Richard A. Hord Washington, NASA, Feb. 1967 44 p refs
(NASA-TR-R-254) CFSTI: HC $3.00/MF $0.65 CSCL 20D

For two gas species with a temperature difference and a bulk velocity difference neither of which is necessarily small in magnitude, the kinetic theory of gases has been used to derive explicit expressions for the collision frequency, diffusive drag force, molecular translational energy transfer rate, and the bimolecular chemical reaction frequency. The derivations, which are based upon hypothesized mutual collision diameters, activation energies, and steric factors, are of interest in connection with theoretical studies of low-pressure gas mixtures with large departures from equilibrium. A binary temperature concept is introduced as an aid in condensing and interpreting the expressions derived from the kinetic theory. The expression derived for the diffusive drag force is used to give a more definite form to the equations of motion of the individual species in a mixture of several interdiffusing gases. Author

N67-16658# Avco-Everett Research Lab., Everett, Mass.
WEAK HYDRAULIC JUMPS IN SHALLOW WATER
James Witting (MIT) Oct. 1966 23 p refs Submitted for Publication
(Contracts AF 49(638)-1483; Nonr-2524(00))
(Avco-Everett Res. Rept.-260; AD-642017)

An experimental study of weak hydraulic jumps into shallow water was undertaken in order to better understand the effects of dispersion and surface wave turbulence on jump structure. Froude Numbers ahead ranged from 1.0 to 2.5, and heights ahead ranged from 0.15 cm to 8 cm. Results are: (1) The transition Froude Number between purely laminar hydraulic jumps and those containing some surface turbulence increases with decreasing depth. (2) Surface turbulence is effective in reducing the amplitude of wave trains behind hydraulic jumps into fairly shallow water to very small values at Froude Numbers not much larger than the transition Froude Number. (3) The nondimensional jump front thickness at given Froude Numbers between 1.35 and 1.75 increases with decreasing depth. An explanation of these results is given. Author (TAB)

N67-16669*# Georgia Inst. of Tech., Atlanta.
STUDY OF THE PRESSURE DISTRIBUTION ON OSCILLATING PANELS IN LOW SUPERSONIC FLOW WITH TURBULENT BOUNDARY LAYER
E. F. E. Zeydel Washington, NASA, Feb. 1967 58 p refs
(Contract NAS2-2897)
(NASA-CR-691) CFSTI: HC $3.00/MF $0.65 CSCL 01A

A theoretical analysis for the unsteady pressure distribution and generalized aerodynamic force on an oscillating wall of finite extent in the chordwise direction with a thick boundary layer is presented. The analysis is based on a two-dimensional model for the turbulent boundary layer of given velocity profile. Linearized potential flow theory is applied and the finite chord case is treated by using Fourier integral techniques. The theoretical equations for a thick, two-dimensional boundary layer with small perturbations are also presented. Author

N67-16676*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL STUDY OF STEADY-STATE AND DYNAMIC PERFORMANCE OF A PROPORTIONAL FLUERIC DIVERTER VALVE
Milton J. LeRoy, Jr. Washington, NASA, Jan. 1967 13 p refs
(NASA-TM-X-1293) CFSTI: HC $3.00/MF $0.65 CSCL 13K

A proportional flueric divarter valve, designed to handle an air flow of four pounds per second, was tested to determine its steady-state and dynamic characteristics. Steady-state performance of the valve is presented for a range of supply flows and discharge restrictions (load). Dynamic performance was investigated by frequency response testing. Steady-state test results showed that maximum flow recovery decreased with an increase in load but was independent of supply flow. Flow gain decreased with increasing load or supply flow. Valve operating characteristics with respect to linearity and hysteresis were very good. Dynamic performance during frequency response tests produced a constant amplitude ratio to 15 cps and a phase lag linearly increasing with frequency. In this frequency range, therefore, the transfer function was that of dead time (0.019 sec). Author

N67-16694*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL PERFORMANCE EVALUATION OF A 6.02-INCH RADIAL-INFLOW TURBINE OVER A RANGE OF REYNOLDS NUMBER
Donald E. Holeski and Samuel M. Futral, Jr. Washington, NASA, Jan. 1967 23 p refs
(NASA-TN-D-3824) CFSTI: HC $3.00/MF $0.65 CSCL 10A

An experimental performance evaluation of a 6.02-inch-tip-diameter radial-inflow turbine using argon as the working fluid was made over a range of inlet total pressure from 1.2 to 9.4 pounds per square inch absolute with corresponding Reynolds numbers from 20,000 to 225,000. Reynolds number, as used herein, is defined as the ratio of the weight flow to the product of viscosity and rotor tip radius, where the viscosity is determined at the turbine-entrance condition. Efficiency and equivalent weight flow increased with increasing inlet pressure and

Reynolds number. At design equivalent speed and pressure ratio, the total efficiency increased from 0.85 to 0.90, while the static efficiency increased from 0.80 to 0.84 with increasing Reynolds number. The corresponding increase in equivalent weight flow was about 2 percent. The relation observed between experimentally determined efficiency and Reynolds number indicated that approximately 70 percent of the turbine losses are associated with wall and blade boundary layers. A study was made at design Reynolds number for determining the probable error of a single observation for measured variables and calculated quantities. The results from a 16 data point set revealed that the probable errors in total and static efficiencies were ±0.009 and ±0.008, respectively. The results were extended over the Reynolds number range and showed that an increase in probable error occurs as Reynolds number decreases. Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N67-15350# Wisconsin Univ., Madison. Dept. of Meteorology.
AERIAL SURVEY OF HUDSON BAY SURFACE TEMPERATURE, 1965
Wayne M. Wendland and Reid A. Bryson Jul. 1966 35 p
(Contract Nonr-1202(07))
(TR-28; AD-642018) CFSTI: HC $3.00/MF $0.65

Airborne temperature surveys of Hudson Bay were accomplished on 8 August 1965 and between 22 and 24 September 1965. The temperature of the surface water was remotely sensed with a Barnes IT-2 Infrared Thermometer, and radiation components were measured with a Suomi-Kuhn net radiometer and Kipp and Zonen solarimeters. The northern part of the Bay cooled about 5C from August to September. In September, the surface water temperatures ranged from slightly more than 5C to slightly less than zero. The temperature pattern showed a cold water tongue extending southward along the western shore. A relatively warm arm extended from Cape Churchill to the northeast part of Hudson Bay. A relatively cold protrusion extended southward between Coats and Mansel Islands in the northeastern part of the Bay. The east-central portion was dominated by a rather large (about 6,000 square miles) cold area with temperatures less than 1C. Author (TAB)

N67-15354# Weizmann Inst. of Science, Rehovoth (Israel). American Committee.
RESEARCH ON THEORETICAL SEISMOLOGY Final Report, Jul. 1, 1965–Jun. 30, 1966
C. L. Pekeris 30 Aug. 1966 27 p refs
(Contract Nonr-2189(00))
(AD-614201) CFSTI: HC $3.00/MF $0.65

Contents: Theoretical seismograms for propagation in a flat earth; Determination of theoretical seismograms for propagation in a spherical earth; Seismic travel times derived from the Pacific nuclear explosions; Revision of the Jeffreys-Bullen travel time tables; Application of rational approximations to the solution of problems in theoretical seismology. TAB

N67-15420# Sylvania Electric Products, Inc., Waltham, Mass. Applied Research Lab.
AMPLITUDE STATISTICS OF LIGHTNING DISCHARGE CURRENTS AND ELF AND VLF RADIO NOISE
Janis Galejs Sep. 1966 23 p refs
(Contract Nonr-3185(00)(FBM))
(RR-511; AD-642539) CFSTI: HC $3.00/MF $0.65

The received noise is considered as the result of integrating several atmospherics during the response time of the receiver. The probability distributions of this noise, and of the current in lightning flashes are related by a twofold Hankel transform. The derived current for very large amplitudes. This characteristic has been used to extend measured lightning statistics to larger amplitudes. The resulting received noise is characterized by a Rayleigh distribution for small signals, and the distribution is inversely proportional to the squared amplitudes for large signals. The present calculations provide amplitude distributions of the received noise which approximate measured noise characteristics more closely than in earlier work, which was based on the approximation of measured current distributions by two exponentials. Author (TAB)

N67-15421*# Israel Program for Scientific Translations, Ltd., Jerusalem.
ACHIEVEMENTS OF SCIENCE: GEOPHYSICS, 1962
I. A. Khvostikov, ed. 1966 141 p refs Transl. into ENGLISH of the book "Itogi Nauki: Geofizika" Moscow, Akad. Nauk SSSR, 1964 Published for NASA and NSF
(NASA-TT-F-383; TT-66-51020) CFSTI: HC $3.00/MF $0.65
CSCL 08K

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N67-15425*# Israel Program for Scientific Translations, Ltd., Jerusalem.
STRUCTURE OF THE CRUST AND OF THE UPPER PART OF THE EARTH'S MANTLE FROM GEOPHYSICAL DATA
I. S. Berzon and P. S. Veitsman *In its* Achievements of Sci.: Geophys., 1962 1966 p 60–76 refs (See N67-15421 06-13) CFSTI: HC $3.00/MF $0.65

The principal trends and results of the work of Soviet and foreign geophysicists concerned with the investigation of the terrestrial crust and upper part of the mantle are reviewed, and an extensive bibliography presented. Groups of problems treated are: earth crust and upper mantle investigation, their structure in essentially different zones, geological interpretation of geophysical results, and the international upper mantle project. Geological, geophysical, seismological, gravimetric and aeromagnetic research methods are listed for such topics as: earthquakes, terrestrial crust thickness, depth of M surface, continential and oceanic crust, and mountain structures. R.LI.

N67-15426*# Israel Program for Scientific Translations, Ltd., Jerusalem.
GENERAL SEISMOLOGY
E. A. Koridalin *In its* Achievements of Sci.: Geophys., 1962 1966 p 77–104 refs (See N67-15421 06-13) CFSTI: HC $3.00/MF $0.65

Current trends in seismological instrumentation and equipment development, the physics of earthquakes, seismicity of individual regions of the earth, and applied seismology are reviewed, and an extensive bibliography presented. Of special interest are seismic methods that are used to detect nuclear, and in particular, underground explosions. Radio and electronic devices, mathematical

high-speed computers, as well as new detectors, recording and processing instruments are mentioned. The division of seismoactive territories into regions of different seismicities, special construction measures to increase quake stability, calculation of vibration for dams constructed in seismoactive regions, and seismic detection of nuclear explosions are some areas mentioned for seismological engineering applications. R.Ll.

N67-15427*# Israel Program for Scientific Translations, Ltd., Jerusalem.

EXPLORATION GEOPHYSICS

E. V. Karus *In its* Achievements of Sci.: Geophys., 1962 1966 p 105–129 refs (See N67-15421 06-13) CFSTI: HC $3.00/MF $0.65

Geophysical exploration methods for investigating the earth crust, and mineral prospecting concepts are reviewed. Listed are results of exploratory geophysics and the development of new methods, leading to a rise in geological efficiency, precision of methods, and increased productivity, accompanying a decrease in costs. Briefly outlined are methods to research ore-bearing regions, such as aerial magnetic, gravimetric, seismic, and electric prospecting. Seismic prospecting techniques reported make use of intermediate magnetic recording, acoustic logging, and ultrasonic simulation. Improvements in high-precision gravimetric instrumentation are briefly recorded. Micromagnetic surveying and paleomagnetic investigations are included, as well as electric surveying and radiometry techniques. R.Ll.

N67-15454*# Israel Program for Scientific Translations, Ltd., Jerusalem.

TURBULENT MOTIONS IN THE UPPER ATMOSPHERE AT HEIGHTS OF 80–110 KM ACCORDING TO RADIO OBSERVATIONS OF METEOR TRAINS

I. A. Delov *In its* Phys. of Comets and Meteors 1966 p 81–90 refs (See N67-15441 06-30) CFSTI: HC $3.00/MF $0.65

Results of studies on turbulent motions at the height of 80–110 km obtained by radio observations of meteor trains are presented. Observations were made with a four-site coherent-pulse technique, and a pulse transmitter was installed in one of the sites. Signals scattered by the meteor trains were received at the field sites, relayed, and then recorded on film. The velocity components were thus measured at three distinct sections of the meteor train. The range-amplitude characteristics of the radio echo were recorded for four sections of the train. Some 200,000 wind-speed records were obtained. In 3000 cases the reflections were recorded at no less than three points of the train. The analysis of the records enabled estimation of the turbulence parameters in the meteor zone, and also data on their vertical, seasonal, and diurnal variations. S.P

N67-15461*# Israel Program for Scientific Translations, Ltd., Jerusalem.

OPTICAL INSTABILITY OF THE EARTH'S ATMOSPHERE

N. I. Kucherov, ed. 1966 179 p refs Transl. into ENGLISH of the book "Opticheskaya Neustoichivost' Zemnoi Atmosfery" Moscow, Izd. Nauka, 1965 Published for NASA and NSF (NASA-TT-F-437; TT-67-51372) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Articles on chromatic refraction, image pulsation and scintillation, astroclimate, and automation of observational techniques are presented. For individual titles see N67-15462–N67-15481.

N67-15465*# Israel Program for Scientific Translations, Ltd., Jerusalem.

SOME RESULTS OF DIRECT OBSERVATIONS OF REFRACTIONAL FLUCTUATIONS IN THE GROUND LAYER AND THE DISTRIBUTION PARAMETERS OF THE FLUCTUATIONS

N. I. Kozhevnikov *In its* Opt. Instability of the Earth's Atmosphere 1966 p 26–30 refs (See N67-15461 06-13) CFSTI: HC $3.00/MF $0.65

Described is an optical scheme for visual and photographic observations of fluctuations in the refractive index of air in the ground layers of the daytime atmosphere. The optical instrument is so arranged that fluctuations in the refractive index cause a deflection of sun rays from the initial direction to reach an apperture and illuminate a screen. Shape and size of the light spots appearing on the screen when the atmosphere is turbulent correspond to a parallel projection of atmospheric inhomogeneities on the objective. The aperture automatically selects those rays which deflect through a preset angle so that the screen displays a distribution of light spots corresponding to the actual distribution of fluctuations. Test results on the atmospheric ground layer indicate that a homogeneous isotropic field of refractional fluctuations seems likely for ground air layers. G.G.

N67-15467*# Israel Program for Scientific Translations, Ltd., Jerusalem.

PULSATION OF AN ARTIFICIAL LIGHT SOURCE IN THE GROUND LAYER

V. M. Bovsheverov, A. S. Gurvich, and M. A. Kallistratova *In its* Opt. Instability of the Earth's Atmosphere 1966 p 33–40 refs (See N67-15461 06-13) CFSTI: HC $3.00/MF $0.65

In the present paper, we investigate the pulsation intensity of the image of an artificial light source as a function of the distance traversed by the light beam in the ground layer and of the mean meteorological parameters. Application of frequency analysis enabled us to establish the energy frequency spectrum of image pulsations and to verify some conclusions of the theory. Author

N67-15468*# Israel Program for Scientific Translations, Ltd., Jerusalem.

IMAGE PULSATION AS A FUNCTION OF ZENITH DISTANCE

O. B. Vasil'ev *In its* Opt. Instability of the Earth's Atmosphere 1966 p 41–49 refs (See N67-15461 06-13) CFSTI: HC $3.00/MF $0.65

Presented is a classification scheme for atmospheric-optical perturbations as derived from geometrical characteristics of the inhomogeneities in the Earth's atmosphere as well as from physical factors differentiating between various disturbances. It incorporates: (1) inhomogeneities or "schlieren" smaller than or equal to the diameter of the objective in the telescope's focal plane produced a diffraction pattern blurred by amplitude and phase fluctuations at frequencies of 10 c/s and higher; (2) scintillation was caused only by amplitude fluctuations of the incoming light waves with frequencies from 0.02 (50-sec period) to 1000 c/s; (3) image pulsation was produced by fluctuations in the path of the light wave due to inhomogeneities larger than the telescope objective at frequencies below 10 c/s; (4) path shifts with periods from 1 min to 5 hrs, and at frequencies from 0.02 to 0.0005 c/s, were called refraction anomalies and were produced by inhomogeneities ranging in size from 10^2–10^3 to 10^4–10^5 objective diameter; and (5) mixing of air masses with atmospheric transparency and refraction alterations below 0.00005 c/s frequency. G.G.

N67-15470*# Israel Program for Scientific Translations, Ltd., Jerusalem.

AN ESTIMATION OF ATMOSPHERIC TURBULENCE AFFECTING SEEING

L. K. Zinchenko *In its* Opt. Instability of the Earth's Atmosphere 1966 p 59–65 refs (See N67-15461 06-13) CFSTI: HC $3.00/MF $0.65

Optical inhomogeneities caused by atmospheric turbulence are analyzed by applying the Richardson number as a criterion to define the distribution of seeing in zenith distance. The following characteristics were calculated for sample nights: vertical

temperature gradient, vertical wind velocity gradient, and Richardson numbers for half-kilometer layers. The vertical distribution of Richardson numbers over any night was highly nonuniform, thus implying that the troposphere was stratified at various altitudes in relation to amount of eddy energy. A higher eddy energy was observed for the atmospheric layer below 2 km, and light waves propagating through this layer were deformed by refractional inhomogeneities. Measurement results pointed to a high correlation between astronomical seeing and the turbulence of the low troposphere as estimated in terms of the Richardson number. G.G.

N67-15471*# Israel Program for Scientific Translations, Ltd., Jerusalem.
FLUCTUATIONS OF SHIMMER ANGLE
G. I. Bol'shakova and Sh. P. Darchiya *In its* Opt. Instability of the Earth's Atmosphere 1966 p 66–81 refs (See N67-15461 06-13) CFSTI: HC $3.00/MF $0.65

Diurnal variations of the shimmer angle were studied and a definite relationship between daytime and nighttime seeing was established: if nocturnal seeing was unstable, the instability persisted during the day, while stable nocturnal seeing led to stable daylight seeing. The recurrence of shimmer angle reduced to zenith with long periods must be taken into consideration when assessing the astroclimatic characteristics of the area. Statistical analysis of the observed material showed that synoptic fronts caused a deterioration in seeing. G.G.

N67-15473*# Israel Program for Scientific Translations, Ltd., Jerusalem.
ASTROCLIMATIC CHARACTERISTICS OF THE SHEMAKHA OBSERVATORY AREA
G. V. Akhundova *In its* Opt. Instability of the Earth's Atmosphere 1966 p 91–96 refs (See N67-15461 06-13) CFSTI: HC $3.00/MF $0.65

Quantitative astroclimatic conditions of the Pirkuli observatory site were studied in order to choose a location for the erection of a 2-m telescope. Results of zenith shimmer disk estimates for 396 nights and of 243 photographic plates with 881 stellar trails showed that the mean amplitudes of pulsation and shimmer in the zenith were close to 0".10. The minimum image size that can be expected for Pirkuli is close to 0".5. G.G.

N67-15474*# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE ASTROCLIMATE OF TADZHIKISTAN
O. P. Vasil'yanovskaya *In its* Opt. Instability of the Earth's Atmosphere 1966 p 97–106 refs (See N67-15461 06-13) CFSTI: HC $3.00/MF $0.65

Investigations of the astroclimate in Tadzhikistan established the Sanglok site as superior from an astrogeophysical standpoint. Visibility reductions at approach of a synoptic front were much slower than at other sites, star image pulsations and scintillations were minimal, temperatures fluctuated only in small amplitudes, horizon exposure was excellent, and the whole area also possessed a favorable topography in comparison with other sites. G.G.

N67-15475*# Israel Program for Scientific Translations, Ltd., Jerusalem.
ASTROCLIMATIC CHARACTERISTICS OF THE CHECHEKTY SITE IN EASTERN PAMIR
A. Kh. Kurmaeva and Sh. P. Darchiya *In its* Opt. Instability of the Earth's Atmosphere 1966 p 107–116 refs (See N67-15461 06-13) CFSTI: HC $3.00/MF $0.65

The climatic conditions in Eastern Pamir are very rigorous, atmospheric precipitation is negligible, and the landscape arid and desert like. High elevation and low air temperatures are responsible for low air moisture content throughout the year. Ranges surrounding the Chechekty natural observation area give protection against sand dust storms raised by concentrated wind in the lower atmospheric layers during daytime. The winds subside or cease altogether by night time. Nocturnal and diurnal temperature variations are very large, but only one night out of 62 nights was clouded. Telescopic star observations and estimated image pulsations for the above studied area together with its astroclimatic characteristics established it as an advantageous site for observations on star image quality and image pulsation. G.G.

N67-15477*# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE ASTROCLIMATE OF NOVOSIBIRSK
A. D. Skoropupov *In its* Opt. Instability of the Earth's Atmosphere 1966 p 123–138 refs (See N67-15461 06-13) CFSTI: HC $3.00/MF $0.65

Astroclimatic observations in Novosibirsk were performed in order to select a suitable site for the erection of an astronomical observatory. Combined visual and photographic data obtained during day and night at 4 hours interval, together with recordings of wind velocity, humidity, air temperature, soil temperature, atmospheric pressure and transparency, precipitation, solar radiation readings, etc., were evaluated and six different kinds of functional dependence between seeing and zenith distance emerged. Further analysis of possible observation sites found that the above mentioned area possessed an astroclimate comparable to some places in the Caucasus. G.G.

N67-15483# Wolf Research and Development Corp., Bladensburg, Md. Applied Sciences Dept.
UNIFIED GEODETIC PARAMETER PROGRAM (GEOPS). VOLUME I: MATHEMATICAL ANALYSIS Final Technical Report, 8 Dec. 1964–25 Mar. 1966
H. R. Kahler and W. T. Wells 25 Mar. 1966 278 p refs
(Contract DA-44-009-AMC-878(X))
(AD-640321) CFSTI: HC $3.00/MF $0.65

A detailed mathematical description is presented associated with the computer program which will recursively obtain minimum variance estimates of orbital parameters, geopotential coefficients, station locations, and tracking systems error model coefficients from measurements taken by diverse electronic and optical tracking systems. TAB

N67-15744*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE SCALE DEPTH OF THE MAIN OCEAN THERMOCLINE
R. C. Alexander *In its* Space Programs Sum. No. 37–41, Vol. IV 31 Oct. 1966 p 200–205 refs (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

An attempt is made to show the physical parameters which govern the scale depth of the thermocline. A family of solutions to the advective problem is discussed, and the relationship between the Welander–Blandford solution and surface boundary conditions is demonstrated. It is noted that the up-welling velocity is now identifiable with the surface conditions and that the derived equations might be regarded as the total solution for an ocean in which the sum of evaporation–precipitation and surface wind stress curl have the required solution form. A.G.O.

N67-15930# Smithsonian Astrophysical Observatory, Cambridge, Mass.
ELECTRON-PROBE ANALYSIS OF INTERIORS OF MICROSCOPIC SPHEROIDS FROM ERUPTIONS OF THE MT. ASO, SURTSEY, AND KILAUEA IKI VOLCANOES
Frances W. Wright, Paul W. Hodge, and Ronald V. Allen 22 Nov. 1966 12 p refs
(SAO Special Rept.-228)

Interiors of particles collected from fresh volcanic deposites have been analyzed with a microprobe to allow comparison of them with dust of a possibly extraterrestrial origin. We find support

for the argument that the majority of the possibly extraterrestrial particles collected in old Greenland ice deposits are not volcanic in origin. Author

N67-15970# National Observatory of Athens (Greece). Seismological Inst.
FORESHOCK AND AFTERSHOCK SEQUENCES OF SOME LARGE EARTHQUAKES IN THE REGION OF GREECE
B. Papazachos, N. Delibasis, N. Liapis, G. Mourmoulidis, and G. Purcaru 1 Jul. 1966 143 p refs Submitted for Publication
(Contract AF 61(052)-803)
(AFOSR-66-2416; SR-5; AD-641160) CFSTI: HC $3.00/MF $0.65

Deformation characteristics, magnitude and time distributions of the large aftershocks occurred in the region of Greece from 1926 till 1964 are investigated. An approximate relation between the number of aftershocks and the magnitude and focal depth of the main shock has been found. Also, an approximate relation has been derived between the magnitude of the largest aftershock and the magnitude and focal depth of the main shock. The largest aftershock occurs within fourteen days after the main shock. In many cases large late aftershocks occur one or more months after the main shock. One or more foreshocks of magnitude larger than 3.8 occurred in forty per cent of the cases. The probability for an earthquake to be preceded by a large foreshock not much smaller than the main shock is 10%. It is shown that some properties of the earth's material in the aftershock region can be derived by studying the magnitude distribution and deformation characteristics of the aftershocks. Author (TAB)

N67-16005*# National Academy of Sciences–National Research Council, Washington, D. C.
IONOSPHERE
In its Progr. in Sci. Radio 1966 p 139–179 (See N67-16001 06-34) CFSTI: HC $3.00/MF $0.65

Papers are reviewed on: (1) *D-Region Structure and Formation*—Faraday rotation techniques in rocket borne determinations of electron density and collision frequency, N(h) profiles over D-region heights, ionizing mechanisms, and continuity equations at D-region levels; (2) *D-Region Collision Frequencies, Relation to Stratosphere*—calculations on hf radio absorption, electron-collision frequency, and pressure variations with latitude; (3) *The Ionospheric F Region and the Magnetosphere*—mean properties of the F region and magnetosphere, and ionospheric irregularities; (4) *Dynamics of the Ionosphere Over-all Picture and E Region in Particular*—hydrodynamic tides generated in the troposphere and ozonosphere; (5) *Dynamics of the Ionosphere F-Region Phenomena: Interactions Between Movements of Neutral Atmosphere and Ionosphere*—computations on global wind circulation and ion-drag; seasonal and equatorial anomalies, and maintenance of nighttime ionization. G.G.

N67-16006*# National Academy of Sciences–National Research Council, Washington, D. C.
MAGNETOSPHERE
In its Progr. in Sci. Radio 1966 p 181–220 (See N67-16001 06-34) CFSTI: HC $3.00/MF $0.65

The magnetosphere was discussed in the following papers: (1) *Atmospherics I: Characteristics of Atmosphere at the Source and Propagation*—spectra of atmospherics with peaks around 8, 14, 20, and 26 Hz, and diurnal variations of amplitude and frequency; (2) *Whistlers*—radioelectric whistlers; (3) *VLF Radio Waves and Micropulsations*—propagation phenomena, bouncing wave packages, periodic emissions with whistlers, elf waves, and electron microbursts; (4) *New Developments*—Martian atmosphere and ionosphere, electron densities in geomagnetic tails, thermal plasma in magnetosphere, electric field measurements in magnetosphere, satellite observations of ionospheric radio noise, etc.; and (5) *Atmospherics II*—properties of atmospheric noise. G.G.

N67-16024*# Naval Research Lab., Washington, D. C.
EXPERIMENT S-11, AIRGLOW HORIZON PHOTOGRAPHY
M. J. Koomen and R. T. Seal, Jr. *In* NASA, Washington Manned Space-Flight Expt., Gemini IX Mission 1 Nov. 1966 p 13–25 refs (See X67-16021 06-30) CFSTI: HC $3.00/MF $0.65

Forty photographs of night airglow and four photographs of twilight airglow were obtained on June 4, 1966, from the window of the spacecraft during the Gemini IX mission. An f/0.95, 50-mm focal length camera was optically filtered to photograph airglows in visible bands centered at 5577 Å and 5893 Å, where prominent airglow emissions occur due to atomic oxygen and atomic sodium, respectively. Filter combinations with broader spectral coverage were also used. Exposure times were between 2 and 20 seconds, and fine-pointing of the camera was required during exposure. An illuminated camera sight and an adjustable camera mount were used. The photographs show variations in the altitude and intensity of the airglow emissions. Data reduction is still in progress. Author

N67-16130# Emmanuel Coll., Boston, Mass. Oriental Science Library.
COMPARISON OF SEVERAL RADIATION CHARTS
Yun-Hua Chou, Yu-Hai Li, and Ta-Kang Tso Bedford, Mass., AFCRL, May 1966 29 p refs Transl. into ENGLISH from Ch'i Hsiang Hsueh Pao (Peking), v. 34, no. 2, 1964 p 135–145
(Contract AF 19(628)-5073)
(EMM-65-35; TT-65-62897; AD-642401) CFSTI: HC $3.00/MF $0.65

The fundamental equations of eight radiation charts and their computed results are discussed. The effect of pressure and temperature on the transmission functions of the different charts, the absorption and emission of radiation by carbon dioxide and water vapor in the spectral overlapping bands are investigated and a comparison of the various charts for atmospheric emissivity is made. Since these charts give discordant results for the same input, factors causing the discrepancies are analyzed. A preliminary survey on the advantages and disadvantages of each radiation chart is then contemplated in the light of the foregoing discussion. Author (TAB)

N67-16139# Pennsylvania Univ., University Park. Dept. of Geology and Geophysics.
SEISMIC SCALE-MODEL STUDY OF REFRACTION ARRIVALS IN A THREE-LAYER STRUCTURE
David E. Siskind (M.S. Thesis) 21 Jun. 1966 48 p
(Contract AF 19(628)-238; ARPA Order 180-61; Proj. Vela-Uniform)
(AFCRL-66-571; AD-640841) CFSTI: HC $3.00/MF $0.65

One of the uses of seismic waves is in the study of crust-mantle relationships. A crustal model having a narrow intermediate-velocity layer was postulated for comparison with another model, previously studied, having a narrow region of constant velocity gradient. Both models have their narrow regions bounded above by a low-velocity region and below by a region of higher velocity. It was shown experimentally that the same relationship between the velocity gradient and cutoff frequency was found for both studies, with the cutoff frequency being 1.7 times the velocity gradient. The cutoff frequency is defined as the frequency at which the spectrum of the refracted arrival begins to fall off rapidly from the spectrum of the direct wave. A part of the effect is accounted for by noting the theoretically expected fall off of the refracted from the direct spectra of 6 db/octave. Author (TAB)

N67-16157# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
THE EFFECT OF THE FINITE WANTED PULSE WIDTH ON THE RADIO WAVE INTERACTION EXPERIMENTS

Thomas D. Pinkerton 15 Jun. 1966 96 p refs
(Contract Nonr-656(35); Grant NSF GP-846)
(SR-274; AD-640978) CFSTI: HC $3.00/MF $0.65

In the report the wave interaction equations are extended to take into account the finite width of the wanted pulse. The effect of the wanted pulse width upon the wave interaction experiment is then demonstrated through the use of this new equation by showing the effect that it has on the interaction coefficient height profile and by showing its importance in electron density synthesis. The significance of the effect of underlying ionization is demonstrated by evaluating the error that occurs in the synthesized electron density profile when it is neglected. It is also shown that the region of dominant heating plays an important role in determining whether underlying ionization can be neglected in synthesizing the electron density. A technique of obtaining the whole interaction coefficient height profile by making a simultaneous measurement of the fundamental frequency component of the repetitive disturbing pulses and a number of its harmonics is presented and a feasibility study of this technique is made. It is found that this technique can eliminate the long sweep time presently needed to make interaction measurements and could possibly allow data to be reasonably extrapolated to include below its present minimum height. Author (TAB)

N67-16167# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.

A MINERAL TRANSITION IN ATMOSPHERIC DUST TRANSPORT

G. F. Riedmuller and T. L. Barber Aug. 1966 26 p refs
(ECOM-5072; AD-641706) CFSTI: HC $3.00/MF $0.65

The minerals mirabilite and thenardite differ only in number of waters of crystallization, and may easily change from one state to the other. The identification of the minerals in airborne dust by infrared absorption spectroscopy and the rapidity of the transition are discussed. Author (TAB)

N67-16184# Technische Hochschule, Karlsruhe (West Germany). Geophysikalisches Institut.

INVESTIGATIONS ON THE NONELASTIC BEHAVIOR OF THE UPPER MANTLE Annual Summary Report, 1 May 1965–30 Apr. 1966

Stephan Mueller and Karl Fuchs 20 May 1966 60 p refs
(Contract AF 61(052)-861; ARPA Order 612-1; Proj. Vela-Uniform)
(AFOSR-66-1835; ASR-1; AD-641312) CFSTI: HC $3.00/MF $0.65

A procedure for the spectral analysis of seismic body waves is discussed. The specific attenuation factor may only be derived after properly correcting for the effects of instrumental distortion, of the receiver and source crust, the propagation effect in the upper mantle and the source spectrum. Response curves for 5 different seismograph systems are presented. The crust is approximated by a flat layer model. The transfer function for the system of a point source in the crust was derived for three basic types: an explosive source, a single couple and a double couple. The explosive type of point source appears to be more suited for attenuation studies since the source spectrum is simpler than spectra of more complicated source types. Author (TAB)

N67-16241# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

QUANTITATIVE DETERMINATION OF BED PARAMETERS FROM GAMMA-RAY LOGS

J. A. Czubek *In its* Nukleonika, Vol. VIII 1966 p 163–169 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

Quantitative interpretation of gamma-ray logs performed inside the boreholes by means of the continuous measurement is described in this paper. The presented method affords this interpretation in the case of different measurement parameters as θ—the logging speed, τ—the time constant of ratemeter, and the other geological and formation parameters occurring in the geophysical practice. Author

N67-16324# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

CORRELATION BETWEEN THE CONCENTRATIONS OF LEAD-210 (RADIUM D) AND CESIUM-137 IN GLACIER ICE

Z. Jaworowski *In its* Nukleonika, Vol. VIII 1966 p 792–794 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The concentrations of lead-210 (radium D) in the atmospheric air were found to be of the same magnitude as those of strontium-90. It appears that this is also the case with rainwater. A striking feature of the data given is that the rainwater levels of lead-210 and strontium-90 change correlatively in successive years. The data compiled were obtained by different analytical methods and refer to various localities; therefore there exists possibility that the correlation between them might be accidental. More reliable data could be obtained by analyzing samples of rainwater from past years from one locality. Small glaciers render a good opportunity for obtaining such samples as their thin annual stratification of firn and ice enables one to collect the material from relatively shallow shafts. The stratification of the ice renders possible an approximate dating of the samples. This paper presents the results of determination of the lead-210 and cesium-137 contents in water samples from the corrie glacier in the Polish part of Tatra Mountains. Author

N67-16329# International Business Machines Corp., Gaithersburg, Md.

LASA SIGNAL PROCESSING, SIMULATION AND COMMUNICATIONS STUDY Second Quarterly Technical Report, May–Aug. 1966

Bedford, Mass. AFSC, Electron. Systems Div., Aug. 1966 129 p refs
(Contract AF 19(628)-5948; ARPA Order 800)
(ESD-TR-66-514; QTR-2; AD-642439) CFSTI: HC $3.00/MF $0.65

In the first report, 14 May 1966, a functional system description of a LASA signal processing system was hypothesized. Certain system parameters were outlined and bounded to permit a definition of the signal processing concept. This report, discusses important system parameters in greater detail to provide further technical support to the system concept and describes some of the supporting efforts. Sections 1 and 2 describe the work accomplished and plans, respectively. Appendices A to C contain factual detail in the areas of beam analysis, signal processing and processing systems. Appendix D describes effort relating to communications instrumentation. A summary description of the programs currently under development is given in appendix E. Overall program comments and recommendations on relevant topics of seismological interest are presented in appendix F. Author (TAB)

N67-16331# Army Cold Regions Research and Engineering Lab., Hanover, N. H.

COLD REGIONS SCIENCE AND ENGINEERING. PART 1, SECTION A2: PERMAFROST (PERENNIALLY FROZEN GROUND)

S. Russell Stearns Aug. 1966 88 p refs
(CRREL-1-A2; AD-642730) CFSTI: HC $3.00/MF $0.65

The monograph summarizes information on permafrost for engineering construction in cold regions. The distribution and origin of permafrost is discussed and information on structure, thickness, and thermal regime is summarized. Patterned ground and vegetation in the cold regions are discussed and the engineering significance of permafrost is reviewed. Author (TAB)

N67-16369# Illinois Univ., Urbana. Electrical Engineering Research Lab.

IONOSPHERIC RESEARCH Quarterly Progress Report, 1 Apr.–30 Jun. 1966

H. D. Webb Ft. Monmouth, N. J., Army Electron. Command, Oct. 1966 27 p
(Contract DA-36-039-AMC-03703(E))
(ECOM-03703-11; QPR-11; Rept.-11; AD-641795) CFSTI: HC $3.00/MF $0.65

Moon-reflected signals were received on 36 days for a total of approximately 378 hours at 150.6 mc and approximately 67 hours at 413.25 mc. Tables and a graph of observation times are presented. Calculations are virtually complete through the April observations. The influence of the April 15 solar flares is not evident in the data. Quarterly averages of electron content centered around March 21, June 21, and September 21 are presented. The one centered around Jun 21 shows the late afternoon maximum that appears in the summer. The gain of the 28 foot paraboloid using the sun as a source and a comparison method is 18.9 plus or minus 0.5 db. A phase-lock unit to keep the 150.6 mc receiver tuned is being built and installed as part of an automatically operated station. A coordinate converter to control the antenna was procurred. The evaluation of methods of resolving the n x 180 degrees ambiguity in lunar Faraday rotation data and the calculation of electron temperatures is being continued. The Atlas of Lunar Data for 1961 through 1964 is ready for printing Volume IV of the atlas, for 1965 data, is being prepared. Author (TAB)

N67-16374# Air Force Cambridge Research Labs., Bedford, Mass. Meteorology Lab.
FINITE-DIFFERENCE EXPERIMENTS WITH A SIMPLE CONSERVATION LAW
Louis Berkofsky and Ralph Shapiro Aug. 1966 54 p refs *Its* Phys. and Mat. Sci. Res. Paper no. 257
(AFCRL-66-537; AD-640645) CFSTI: HC $3.00/MF $0.65

The authors applied a number of versions of the Lax-Wendroff scheme to obtain solutions of the finite-difference form of a simple conservation law. The principal results, deduced from a large number of numerical experiments, are that the stability of the solutions is highly correlated with the initial conditions, and that the use of a smoothing operator together with the Lax-Wendroff scheme gives the most satisfactory results. Author (TAB)

N67-16404# Boeing Scientific Research Labs., Seattle, Wash. Geo-Astrophysics Lab.
MICROPULSATION MEASUREMENTS DURING THE PUGET SOUND EARTHQUAKE OF APRIL 29, 1965
James F. Kenney and Leonard E. Johnson Aug. 1966 18 p refs
(D1-82-0535; AD-641125) CFSTI: HC $3.00/MF $0.65

The emfs induced in micropulsation coils were analyzed to compute an epicenter and to look for possible magnetic signals generated by the Puget Sound earthquake of April 29, 1965. The epicenter calculated by this method agrees with that published by Algermissen and Hardy (1965) within the limits of experimental error. The search for magnetic precursors yielded negative results. The upper limit to the dipole moment of the stressed region was determined to be 2.5 x 10 to the 13th power cgs emu. It is concluded that, at least in this area, the possibility of using the piezomagnetic effect as a useful pre-indication of earthquake activity is rather remote. Author (TAB)

N67-16439# Ballistic Research Labs., Aberdeen Proving Ground, Md.
UPPER ATMOSPHERE WINDS MEASURED BY GUN-LAUNCHED PROJECTILES
Charles H. Murphy, Gerald V. Bull (McGill Univ.) and Howard D. Edwards (Space Instr. Res., Inc.) May 1966 35 p refs
(BRL-MR-1747; AD-637850) CFSTI: HC $3.00/MF $0.65

The High Altitude Research Project (HARP) uses gun-launched projectiles to probe the upper atmosphere. Under this project, 5-inch projectiles have reached 70 km, and 16-inch projectiles have attained an altitude of 143 km over Barbados, West Indies. The first experimental program for the 16-inch gun has been the production of luminous tri-methyl aluminum (TMA) trails for the measurement of winds above 90 km. In the period July 1964 to February 1966, 49 such nighttime trails were photographed and 29 of these trails have been analyzed. During 42 of these flights, concurrent ionosonde records were taken and the locations of sporadic E layers have been determined for comparison with the wind profiles. The wind data analyzed showed little evidence for the Rosenberg rotating wind vector model, but on nine trails direction reversals occuring in less than 3 km of vertical displacement were observed. Layers of constant direction flow with thicknesses greater than 8 km were observed on 14 trails, and a maximum wind speed of 147 m/sec was measured. The six trails of the night of 20 - 21 September showed a rapid variation of N - S component of wind at fixed altitude with peak-to-peak amplitude of over 200 m/sec. Sine waves were fitted to wind components at fixed altitude with fair to good standard deviations. Author (TAB)

N67-16443# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
SEISMIC WAVE RADIATION FROM SOURCES MOVING OVER A FINITE DISTANCE
Robert S. Crosson and Chi-Chang Chao Aug. 1966 128 p refs
(Contract DA-31-124-ARO(D)-223; Grant NSF GK-47)
(SUDAAR-288; AROD-4702-3; AD-642316) CFSTI: HC $3.00/MF $0.65

A method was developed for solving transient moving point source problems for infinite and semi-infinite elastic media. The method makes use of integral transform techniques and Cagniard's method of inversion. Emphasis was placed on the study of primary wave and surface wave radiation from distributed sources used in exploration seismology. TAB

N67-16468# Pennsylvania State Univ., University Park. Dept. of Geology and Geophysics.
AN EVALUATION OF A METHOD FOR FOCAL-DEPTH DETERMINATION OF SEISMIC DISTURBANCES FROM UNDERGROUND NUCLEAR EXPLOSIONS
Jin-Long Lin 15 Jul. 1966 109 p refs
(Contract AF 19(628)-238; ARPA Order 180-61)
(AFCRL-66-570; AD-640842) CFSTI: HC $3.00/MF $0.65

The Watson-Merdler method for determination of focal depths was applied to fourteen seismograms from underground nuclear explosions. Because the depths for blasts are less than 1 km, the true time delta t for the actual surface reflection was not tested. 200 cases where concentration ratio, C sub R, was greater than in the original seismogram and where the area under the seismogram was reduced were investigated. Causes which can produce simplification are: (1) Deconvolution removes the pP sequence from the seismogram. (2) Deconvolution removes PcP or some other sequence other than pP. (3) Deconvolution produces a larger maximum amplitude in the deconvolved seismogram than in the original. (4) Deconvolution diminishes amplitudes on the seismogram. (5) Deconvolution phases random noise so as to add to or subtract from the principal peaks of the seismic pulse. The doublet-function hypothesis for a seismogram is too simple and is therefore unrealistic. The simplicity criterion may identify many pulses in addition to the pP pulse on the seismogram. The Watson-Merdler method does not show promise to distinguish blasts from earthquakes. Author (TAB)

N67-16473# Aeronautical Chart and Information Center, St. Louis, Mo. Chart Research Div.
ON CORRECTIONS FOR GRAVITY DURING LEVELING IN A HIGH-MOUNTAIN REGION
M. I. Yurkina and E. I. Krotov Oct. 1966 10 p refs Transl. into ENGLISH from Geodez. i Kartograf. (Moscow), Issue 10, 1965 p 3-7
(ACIC-TC-1133; TT-66-62-585; AD-641751) CFSTI: HC $3.00/MF $0.65

Translation of Russian Research: On Corrections for Gravity During Leveling in a High-Mountain Region. Author (TAB)

N67-16517* Consultants and Designers, Inc., Arlington, Va.
ANALYTICAL REPRESENTATION OF THE SECULAR VARIATION [K ANALITICHESKOMU PREDSTAVLENIYU VEKOVOY VARIATSII]
G. Kauttsleben 19 Nov. 1965 7 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 5, no. 4, 1965 p 745–748
(Contract NAS5-3760)
(NASA-CR-81272; ST-GM-10418) CFSTI: HC $3.00/MF $0.65 CSCL 08A

The analytical representation of the main part of the magnetic field is expanded by the description of field dependence on time for the period about from 1850 to 1950. The essential component parts of the secular variation are analyzed. Author

N67-16548*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE IONOSPHERE AT 640 KILOMETERS ON QUIET AND DISTURBED DAYS
B. M. Reddy, L. H. Brace, and J. A. Findlay Dec. 1966 67 p refs
(NASA-TM-X-55646; X-621-66-574) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Electrostatic probe measurements of electron concentration N_e from the TIROS-VII satellite are the basis for a study of the global response of the topside ionosphere to magnetic disturbances at solar minimum. The quiet-time behavior of N_e shows many of the features previously evident in Explorer XXII measurements at 1000 km, the daytime equatorial maximum, the nighttime mid-latitude maximums, and the main trough at the boundary of the polar region. The storm-time response at 640 km takes the form of strong N_e enhancements on middle and high latitudes on the dayside and smaller enhancements on the nightside. At the equator, the storms produce depressions of N_e on the dayside and enhancements on the nightside. It is concluded that the storm-time enhancements of N_e may be explained in terms of the observed thermal expansion of the neutral atmosphere which lifts the entire ionosphere. The different behavior of the equatorial N_e is consistent with electrodynamic drift theory. The storm-time increase of T_e in the polar region may result from additional heating, while the decrease of T_e at all other latitudes is caused by both increased collisional cooling to the expanded neutral atmosphere and by a decrease in the escape flux of photoelectrons which heat the upper F-region. Author

N67-16550*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MEASURED TEMPERATURE STRUCTURE IN NOCTILUCENT CLOUDS
John S. Theon, W. Nordberg, and W. S. Smith Dec. 1966 21 p refs
(NASA-TM-X-55648; X-621-66-597) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Acoustic grenade soundings were carried out from Kronogard, Sweden (66°N) and Barrow, Alaska (71°N). The results of the observations at Barrow display remarkable uniformity with temperature variations generally on the order of 3° to 4°K at any given altitude throughout the mesosphere. Soundings were made alternately with and without noctilucent cloud displays within a period of less than 48 hr; no significant difference in the temperature structure was noted between the presence and absence of clouds. Of the six soundings conducted at Kronogard, four were carried out during noctilucent cloud displays and two served as control soundings. The mesopause temperatures ranged from 130° to 148°K and no significant difference in the mesopause temperature was observed between the cloud and no-cloud categories. It was concluded that noctilucent clouds are composed of particles that grow, by a process of sublimation, to sufficient size to scatter sunlight as they fall through or are suspended in the low temperature mesopause and that a mesopause temperature of less than 140° to 150°K is a necessary but not sufficient condition for the existence of noctilucent clouds. Author

N67-16552*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TEMPORAL VARIATIONS OF MESOSPHERIC OXYGEN AND OZONE DURING AURORAL EVENTS
Kaichi Maeda and A. C. Aikin Jan. 1967 72 p refs
(NASA-TM-X-55651; X-640-67-29) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Temporal solutions are given of the photochemical equations describing the distribution of ozone and atomic oxygen in an oxygen atmosphere for the equatorial and polar regions. Similar calculations are applied to auroral events, and indicate a strong dependence of mesospheric atomic oxygen on the intensity and energy spectrum of auroral electrons, which dissociate molecular oxygen. It is shown that there can be no significant atmospheric ozone and atomic oxygen modifications due to soft spectrum electron events which appear to characterize most bright auroras. On the other hand, the hard spectrum auroral electrons which appear in most weak, quiet auroras should cause significant increases in the atomic oxygen and ozone concentration below 80 km, provided their flux is more than 10^6 per cm^2 sec. Author

N67-16598# Isotopes, Inc., Westwood, N. J.
PROJECT STARDUST Eleventh Progress Report, Sep. 1963–Sep. 1965
Herbert W. Feely, Pierre E. Biscaye, Ben Davidson, and Harold Seitz 1 Jul. 1966 238 p refs
(Contract DA-49-146-XZ-079)
(DASA-1821; AD-642279) CFSTI: HC $3.00/MF $0.65

Work performed on Project Stardust during the two year period, September 1963 to September 1965 is reviewed. Changes in the sampling and analytical programs are summarized. The stratospheric distributions of radioactive debris from nuclear weapon tests are described. Nuclides described include strontium-90, cesium-137, plutonium-239, manganese-54, iron-55, antimony-124, yttrium-88, sodium-22, cadmium-109, silver-110 and carbon-14. The stratospheric distributions of plutonium-238 from a SNAP-9A burnup, of several cosmic ray products and of lead-210 and plutonium-210 are discussed. Progress in the design of the Stardust numerical model of transfer and rainout of stratospheric radioactive materials is summarized. Author (TAB)

N67-16700*# Mellon Inst., Pittsburgh, Pa.
X-RAY DETECTION OF DISORDERED ORTHOPYROXENES IN METEORITES Semiannual Report, Jun. 1–Nov. 30, 1966
S. S. Pollack 1966 29 p refs
(Grant NGR-39-008-013)
(NASA-CR-81376) CFSTI: HC $3.00/MF $0.65 CSCL 08G

Pyroxenes from approximately 60 meteorites were examined by means of the Debye–Scherrer powder technique, and one-third of these were also examined using oscillation and Weissenberg single-crystal techniques. Both powder and single-crystal diffraction techniques were used in the detection of disordered orthopyroxene in the meso-siderites, enstatite chondrites, and ordinary chondrites. The powder technique was most useful in identifying the pyroxene in the first two groups because they were more uniform and contained less plagioclase than the ordinary chondrites. S.P.

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N67-15341# Rand Corp., Santa Monica, Calif.
INSPECTION BY SMALL SATELLITES
Merton E. Davies Oct. 1966 19 p refs
(P-3410; AD-640864) CFSTI: HC $3.00/MF $0.65

Prospects are presented on the use of inspection satellites for obtaining photographs of the earth. It is suggested that the satellites would disclose military buildups and violations of certain arms control agreements. TAB

N67-15379# Royal Armament Research and Development Establishment, Woolwich (England).
A NEW TECHNIQUE FOR MEASURING THE YAW OF A SHELL
H. G. Haden *In* AGARD The Fluid Dyn. Aspects of Ballistics 1966 p 375–380 refs (See N67-15361 06-12) CFSTI: HC $3.00/MF $0.65

Details are given on a method of observing the spin and yaw of a shell along the whole trajectory. A pinhole in the side of the shell admits sunlight on to an axially situated, V-shaped photocell, generating voltage pulses as the shell spins. These are transmitted to a ground based receiver, and the time intervals between the pulses enable the spin and yaw to be evaluated. This technique has been used successfully to find nutation and precession periods, yaw damping, and spin deceleration. It is of particular use in observing yaw at the vertex in high angle fire. Author

N67-15403# Air Force Cambridge Research Labs., Bedford, Mass. Terrestrial Sciences Lab.
TEST RESULTS OF A HIGH-SPEED CAPPING SHUTTER FOR LARGE-APERTURE GEODETIC CAMERAS
M. S. Tavenner and D. G. Abby Jun. 1966 36 p refs *Its* Instr. Paper no. 101
(AFCRL-66-405; AD-640589) CFSTI: HC $3.00/MF $0.65

Experiments were made with passive satellites for obtaining geodetic information using methods of stellar triangulation. Camera shutters for large-aperture cameras have presented a severe problem in timing. Using a contractor-developed capping shutter, a series of field tests was conducted with the Air Forces PC-1000 Geodetic Stellar Camera System for observations of the Echo I satellite. The report is concerned with the results of this test series and an evaluation of the capping shutter as adapted to the PC-1000 camera system. Author (TAB)

N67-15438# National Bureau of Standards, Boulder, Colo.
THE LONG-TERM PERFORMANCE OF TWO RUBIDIUM VAPOR FREQUENCY STANDARDS
B. E. Blair and A. H. Morgan 22 Jun. 1966 37 p refs
(NBS-TN-341) GPO: $0.25

Since mid-1961 two rubidium vapor frequency standards have been used as transfer or working frequency standards (WFS). The WFS provides a continuously available frequency which is periodically calibrated in terms of the United States Frequency Standard (USFS). This paper evaluates these calibration data over a 44.5-month period of time. It gives the long-term performance of the rubidium standards in terms of the USFS, compares them with a commercial cesium-beam frequency standard, and presents their reliability characteristics as shown by the mean-time-between-failures. The calibration data are graphed with applicable tolerance limits for the between-adjustment periods. The average standard error of estimate about least squares lines fitted to the frequency data is about 2 parts in 10^{11}. The rubidium standards also show a rather consistent daily aging rate of parts in 10^{13}. This would indicate that the frequency of either unit would change a few parts in 10^{10} if operated continuously for one year without any frequency adjustments. Author

N67-15457*# Pennsylvania State Univ., University Park. Dept. of Electrical Engineering.
EVALUATION OF THE CONSTANT MOMENTUM MASS SPECTROMETER FOR IONOSPHERIC INVESTIGATIONS
H. M. Luther 1 Nov. 1966 37 p refs
(Grant NGR-39-009-32)
(NASA-CR-81186; SR-283) CFSTI: HC $3.00/MF $0.65 CSCL 20F

A mass spectrometer is being developed in which pulsed fields give all ions the same momentum. The final ion energy is therefore mass dependent. A mass spectrum can be obtained by analyzing the energy distribution of the ions reaching the collector. The advantages of this type of spectrometer are compactness, simplicity, light weight, absence of magnets, and ability to operate at comparatively high pressures. These characteristics make the apparatus suitable for analyzing the ion composition of the lower regions of the ionosphere. Preliminary results of attempts to find operating conditions insensitive to initial ion energies are discussed. Author

N67-15462*# Israel Program for Scientific Translations, Ltd., Jerusalem.
CHROMATIC REFRACTION AND ITS RELATION TO LARGE-TELESCOPE GUIDING
O. A. Mel'nikov, G. G. Langauer, and N. F. Kuprevich *In its* Opt. Instability of the Earth's Atmosphere 1966 p 1–6 refs (See N67-15461 06-13) CFSTI: HC $3.00/MF $0.65

Chromatic refraction of telescopes with focal distances in excess of 3 m was studied for its influence on high precision astrophotography. Distortions of spectrometric gradients were used to calculate the distorted isophote wavelengths, the corresponding refractive index of the ground air, and finally the chromatic refractions. Experimental aspects of the problem were examined by taking photographs of binaries at 0.04 sec exposure through a 285-mm television telescope with subsequent enlargement on kinescopic screen. These first experimental photographs were judged inadequate for reaching definite conclusions concerning differential chromatic refraction. G.G.

N67-15479*# Israel Program for Scientific Translations, Ltd., Jerusalem.
A PROGRAMMED TELESCOPE DRIVING SYSTEM
Z. N. Kuteva and Yu. A. Sabinin *In its* Opt. Instability of the Earth's Atmosphere 1966 p 145–150 ref (See N67-15461 06-13)
CFSTI: HC $3.00/MF $0.65

A programmed automatic guiding system for transparency survey telescopes was built and tested. Transparency survey telescopes are used in observations of a limited number of stars, and automatic pointing and guiding can therefore be achieved with continuous operation elements. The accuracy attainable with these systems depends on the complexity of the electronic circuitry employed. Some programmed guiding systems using rotating transformers (RT) are discussed. Author

N67-15480*# Israel Program for Scientific Translations, Ltd., Jerusalem.
FLUCTUATION OF STAR IMAGES AND AUTOMATIC TELESCOPE GUIDING
P. V. Nikolaev *In its* Opt. Instability of the Earth's Atmosphere 1966 p151–163 refs (See N67-15461 06-13) CFSTI: HC $3.00/MF $0.65

Considered are the biased errors in telescopic driving and their general variations. The permissible error for automatic guidance systems is taken as: $\epsilon = 0.2d$ where d is the diameter of the star image in the focal plane of the main telescope. Errors from image scintillation and amplifier noises, together with position fluctuation errors, should not exceed the permissible value of ϵ. This can be achieved by representing fluctuations at the tracker input as a

sum of several sinusoidal functions with constant amplitudes and known frequencies, or by statistical characterization of input signal fluctuations. It was concluded that effective automatic guidance systems cannot be designed unless the spectral densities and correlation functions can be expressed in absolute magnitudes. G.G.

N67-15481*# Israel Program for Scientific Translations, Ltd., Jerusalem.

AUTOMATIC AND SEMI AUTOMATIC INSTRUMENTS FOR IMAGE PULSATION MEASUREMENTS FROM PHOTOGRAPHIC STAR TRAILS

O. B. Vasil'ev and V. S. Sumin *In its* Opt. Instability of the Earth's Atmosphere 1966 p 164–174 refs (See N67-15461 06-13) CFSTI: HC $3.00/MF $0.65

Described are microphotometer systems that take pictures when the driving mechanisms of their telescopes are stopped; thus, a star's image is stretched into a thin trail which displays a certain waviness due to the pulsation of the star. Pulsation amplitude is determined by calculating the rms deviations of the individual trail points from the mean trail line. The negative optics system of the microscope is set so that the cross hairs of the eyepiece micrometer travel approximately along the trail; continued adjustment of the eyepiece micrometric screw as it guides the cross hairs along the trail midline is coupled to a potentiometer voltage which reproduces trail topology exactly. The micrometric screw of the carriage for some models is rotated by reversible motor so that the carriage moves at 9 mm/sec and the slit image covers successively all the points of the measured trail section. G.G.

N67-15670*# General Electric Co., Schenectady, N. Y.

STUDY OF HOT-CATHODE MAGNETRON ION GAUGE

J. M. Lafferty, W. D. Davis, and L. J. Favreau Washington, NASA, Jan. 1967 32 p refs

(Contract NAS5-9229)

(NASA-CR-701) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A study was made of the problems associated with the operation and calibration of vacuum gauges at pressures below 10^{-10} torr, particularly the hot-1 cathode magnetron gauge as developed by Lafferty. Under proper operating conditions, the output of this gauge was linear with pressure to 3×10^{-12} torr with indications of normal behavior to at least 1×10^{12} torr. Considerable information was also obtained on a commercial cold-cathode magnetron or discharge gauge. Calibration at lower pressures is limited at present by the system base pressure. The possibility of developing a high output ion source for a quadrupole mass spectrometer using the hot-cathode magnetron principle also was explored. Sensitivities of 1 to $5\times10^{\times3}$ amp/torr were obtained for a suitably focused ion beam, but a more extensive determination of the stability of the source, the energy spectrum of the ion beam, and the requirements of the mass analyzer are necessary before the maximum output can be stated. Author

N67-15673*# National Research Corp., Cambridge, Mass.

DEVELOPMENT OF A MASS SPECTROMETER SYSTEM Summary Technical Report, 1 Jun. 1965–21 May 1966

F. L. Torney, Jr. and P. Blum Nov. 1966 43 p refs

(Contract NAS1-2691)

(NASA-CR-66257) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A cold cathode ion source (CCIS) of the magnetron type has been developed for use in ultrahigh vacuum residual gas analysis. The purpose is to eliminate the spurious spectra produced by the conventional, hot filament ion source and to produce increased sensitivity. Studies were conducted using a commerical quadrupole spectrometer; the quadrupole is suitable because of its relative tolerance for a broad ion beam and a large spread in ion energies. The commerical unit was not optimally designed for the CCIS, but allowed both its performance and potential to be evaluated. Cold cathode quadrupole performance was studied as a function of numerous parameters to determine optimum operating conditions. Resolution of mass peaks 0.7 mu apart was ultimately achieved, with the valley between peaks less than 10% the height of either adjacent peak. This resolution was identical to that obtained with the commerical hot filament source accompanying the spectrometer and appeared limited by the quadrupole itself. Sensitivity exceeded that obtained with the hot filament source. Author

N67-15674* General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility.

BREADBOARD MODEL OF SOLAR PROTON-ALPHA SPECTROMETER

28 Feb. 1966 26 p

(Contract NAS9-4863)

(NASA-CR-65571; FZK-292) CFSTI: HC $3.00/MF $0.65 CSCL 03A

A description of the electronic's functions performed in a solar proton-alpha telescope, spectrometer is presented. The spectrometer uses an array of absorbers and eight solid-state detectors to provide signals which are used to determine alpha and proton energies and to discriminate between the two particles. A logic system is used to select an acceptable particle entrance direction and to identify the types of particles. One electronic output signal is used to develop a pulse height proportional to the energy deposited in the first two detectors; a second output indicates the position of termination of the particle (if it is stopped) in any of the six remaining detectors, thereby yielding the particle energy. Author

N67-15680* Rice Univ., Houston, Tex. Dept. of Space Science.

ELECTRON AND PROTON SPECTROMETER FEASIBILITY STUDY AND BREADBOARD FABRICATION Final Report, 1 Jul. 1965–31 Aug. 1966

Brian J. O'Brien Nov. 1966 38 p refs

(Contract NAS9-4822)

(NASA-CR-65567) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The design, construction, calibration, and testing of a versatile detector of charged particles for possible utilization in manned spacecraft missions, specifically in the Apollo Lunar Surface Experiments Package, is reported. Presented are data on the high-voltage switching power supply, channeltron amplifiers and discriminators, switching logic, performance verification, and inherent problems associated with the use of such devices as ultra-violet rejection. Miscellaneous comments that are pertinent to the study and which were utilized to produce the optimum configuration and the most effective instrumentation are also included. It is envisaged that this unit will permit an extraordinary single-sweep coverage of charged particle fluxes over an energy range of more than one thousand to one, and a dynamic range of 10^8 to one. It is concluded that the instrument will permit measurement of particle fluxes in the plasma, auroral, interplanetary and Van Allen domains of energy; and that it is ideally suited, for example, for space probes or projects where the charged-particle environment is unknown. S.C.W.

N67-15697* National Aeronautics and Space Administration, Washington, D. C.

SCANNING-ELECTRON-BEAM DENSITOMETER FOR MEASUREMENTS OF DENSITY DISTRIBUTION IN A RAREFIED GAS FLOW

Hakuro Oguchi, Hiroki Honma, Junkichi Bessho, and Chihaya Ogusu Dec. 1966 15p refs Transl. into ENGLISH from Rept. of the Space and Aeron. Lab. of the Univ. of Tokyo, v. 2, no. 1(A), 1966 p 92–100

(NASA-TT-F-10498) CSCL 14B

For the purpose of measuring the density distribution of low-density gas flow in a short time, we have designed a densitometer using an electron beam which is scanned in parallel by means of an electronic lens. In this paper we report on its

structure and capability, as well as on the result of the density distribution measurement of a shock wave layer in front of a sphere placed in a rarefied gas flow of a gun-tunnel. Author

N67-15733*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
GENERATION OF HORIZONTAL JITTER REQUIREMENT IN AN ANALOG-SCAN VIDEO SYSTEM
F. C. Billingsley *In its* Space Programs Sum. No. 37–41, Vol. IV 31 Oct. 1966 p 167–169 refs (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

As an adjunct to the development of techniques for digital processing of pictures returned from spacecraft, an investigation was made of film conversion techniques to precisely convert an electrical signal to a film image, and vice versa. The generation of horizontal jitter requirements in an analog-scan video system is presented, and an analytical discussion of the problem of the loss of line resolution due to sample timing errors is included. R.Ll.

N67-15737*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FIELD STABILIZATION OF NMR SPECTROMETERS BY MEANS OF SAMPLES COAXIAL AND EXTERNAL TO THE RECEIVER COIL
D. D. Elleman and S. L. Manatt *In its* Space Programs Sum. No. 37–41, Vol. IV 31 Oct. 1966 p 79–180 (See N67-15701 06-11)
CFSTI: HC $3.00/MF $0.65

Consideration is given to nuclear stabilized nuclear magnetic resonance (NMR) spectrometers for the direct observation of nuclei other than ^{1}H and ^{19}F. The various aspects of techniques for achieving nuclear stabilization of NMR spectrometers are discussed, along with various problems which can arise. It is reported that an elementary addition to common NMR inserts makes achievement of nuclear stabilization rather simple. A cylindrical sample container which can be placed coaxially about common 5-mm inserts was constructed. It was found that a reference sample in such a container has a field that is sufficiently homogeneous to give a signal suitable for locking the field and frequency of an NMR spectrometer with a simple modulation system. The spectra of ^{14}N, ^{13}C, ^{11}B, ^{31}P, ^{19}F, and ^{1}H were successfully recorded when the spectrometer was stabilized on a sample of the corresponding nucleus in such a sample container external to the receiver coil. Resolution of the order of 0.2 to 0.4 cps was achieved for ^{14}N, ^{13}C, ^{11}B, and ^{31}P. C.T.C.

N67-15748*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
EFFECTS OF THERMAL STERILIZATION ON TAPE RECORDER COMPONENTS
B. A. Campbell, J. K. Hoffman, and S. H. Kalfayan *In its* Space Programs Sum. No. 37–41, Vol. IV 31 Oct. 1966 p 216–224 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

The effects of thermal sterilization on the materials and components used in the construction of Mariner IV endless loop type magnetic tape transport are studied. Thermally induced changes in individual materials are investigated as well as the mutual compatibility of the materials in the thermal environment. Results are presented for samples of the various materials classified into categories according to function such as adhesives, encapsulants, elastomers, lubricants, and wire insulations. The effect of outgassed material on metals used in the tape recorder is also discussed. A.G.O.

N67-15807*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PULSE HEIGHT ANALYZER MEMORY
W. J. Schneider *In its* Space Programs Sum. No. 37–40, Vol. 4 31 Aug. 1966 p 109–118 (See N67-15781 06-34) CFSTI: HC $3.00/MF $0.65

The implementation of random access core memory consisting of 512 words, 18 bits in length, intended for application in a space-borne pulse height analyzer is described. Details are presented on the circuit, the elements in the circuits, and the operation. Timing, power consumption, and temperature performance characteristics are given. N.E.N.

N67-15808*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
GAS CHROMATOGRAPHY COLUMN DEVELOPMENT FOR ANALYSIS OF THE MARTIAN ATMOSPHERE
W. F. Wilhite *In its* Space Programs Sum. No. 37–40, Vol. 4 31 Aug. 1966 p 119–123 (See N67-15781 06-34) CFSTI: HC $3.00/MF $0.65

The experimental procedure and the equipment used in the development of column so that nitrogen–carbon monoxide separation could be made are briefly described. The efforts directed toward reducing the analysis time from 55 minutes to 15 minutes are covered. It was found that a recently developed porous polymer bead column packing material enabled resolution of nearly all components in the Martian atmosphere with one gas chromatographic column. N.E.N.

N67-15815*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TAPE RECORDER WITH INCREMENTAL PLAYBACK CAPABILITIES
E. Bahm *In its* Space Programs Sum. No. 37–40, Vol. 4 31 Aug. 1966 p 170–175 refs (See N67-15781 06-34) CFSTI: HC $3.00/MF $0.65

A study was made on the design and performance of the incremental playback tape recorder to determine its feasibility for spacecraft use. The study showed the incremental playback technique to be feasible. The complexity of the control electronics was found to be nonprohibitive for spacecraft applications. The same is true for the power consumption. The error rate is higher than that of constant speed tape recorders, and the control electronics must be carefully adjusted. The latter may be improved by using a slightly more sophisticated detection circuit. The incremental playback has operated for more than 1000 hours with no bearing or motor failure. The only serious unsolved problem concerns the capstan motor. The printed motor's brushes and a thin flexible armature disk make it sensitive to vibration, shock, and weak. The fact that repetition rates of 200 increments/sec are considered adequate shows that the printed motor performs much better than actually required. Data rates above 200 bits/sec can be obtained by operating the recorder in the constant speed mode. R.N.A.

N67-15914*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
X-BAND CONE RF INSTRUMENTATION
C. T. Stelzried *In its* Space Programs Sum. No. 37–42, Vol. III 30 Nov. 1966 p 48–51 (See N67-15901 06-07) CFSTI: HC $3.00/MF $0.65

The x-band cone radio frequency instrumentation is described. This cone is immediately adaptable to the Goldstone Venus and Mars stations antennas and will be used to provide operational performance data of these antennas at 8448 MHz. A total power radiometer, using a maser amplifier and precision waveguide terminations, will be used for the necessary noise temperature calibrations. The experimental x-band 8448 MHz cone can be used with either the Goldstone 85-ft Venus station antenna or the 210-ft Mars station antenna. It will be used to provide information about antenna performance at this frequency. The first installation will be at the Venus station. Preliminary noise temperature calibrations of the receiving system using the horn, maser, and monitor receiver were made. Provisions are made for measuring the horn, ambient and cryogenic wave guide termination VSWR's, maser gain, noise temperature, and for monitoring the receiver local oscillator frequency. S.C.W.

N67-15827*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DSIF FR-900 VIDEO RECORDERS
W. C. Allen *In its* Space Programs Sum. No. 37-42, Vol. III 30 Nov. 1966 p 95-96 (See N67-15901 06-07) CFSTI: HC $3.00/MF $0.65

Three DSIF stations, DSS 12, DSS 61, and DSS 41, are equipped with Ampex FR-900 rotary-head magnetic recorders capable of acquiring video data from the *Lunar Orbiter*. The machine presently installed at each site has a single wideband channel and two auxiliary tracks. The wideband can record either one channel of dc to 5.5-MHz data in an FM mode or one channel of data within a 1- to 10-MHz bandpass in a direct-record mode without bias. The *Lunar Orbiter* video data are acquired from an unrestricted 10-MHz output of the S-band receiver at approximately −10 dbm, amplified to +3 dbm and predetection-recorded directly on the FR-900. Each of the two auxiliary tracks has a 30-kHz bandwidth, on which are recorded a station voice-communication channel and serially coded GMT. A recording of approximately 1 hr can be made on 3800 ft of the 2-in.-wide video tape. Author

N67-16109# Army Materials Research Agency, Watertown, Mass.
EXPERIMENTAL DETERMINATION OF ULTRASONIC TRANSDUCER FREQUENCY RESPONSE
Otto R. Gericke Sep. 1966 13 p refs
(AMRA-TR-66-27; AD-641931) CFSTI: HC $3.00/MF $0.65

An electronic test method for determining frequency response characteristics of ultrasonic transducers is described. The method involves an actual transmission and reception of ultrasonic signals and yields the loop response curve of a transducer. In examining the frequency response of a number of commercially made ceramic transducers, large variations are found. It is concluded that for a correct correlation of ultrasonic test results, the complete transducer response curve should be known and included in the manufacturers specifications. Author (TAB)

N67-16136# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LUMINESCENT INTENSIFICATION
Ye. A. Bukatin 25 Apr. 1966 7 p refs Transl. into ENGLISH from Zh. Nauch. i Priklad. Fot. i Kinematografii (Moscow), v. 10, no. 3, 1965 p 219-220
(FTD-TT-66-34; TT-66-10389; AD-640957) CFSTI: HC $3.00/MF $0.65

The conversion of a silver photographic image into a luminescent one is described. Author (TAB)

N67-16171# Army Engineer Geodesy, Intelligence and Mapping Research and Developing Agency, Fort Belvoir, Va.
LOW LIGHT LEVEL PHOTOGRAPHY Technical Report, Mar.-Oct. 1965
John R. Benton Aug. 1966 53 p refs
(Rept.-32-TR; AD-642167) CFSTI: HC $3.00/MF $0.65

This report presents an analysis of passive, low light level photographic systems using topographic cameras. This analysis was performed to evaluate the applicability of low light level photography to topographic mapping. A theoretical expression for the illumination threshold of a photographic system capable of producing photographs acceptable for map compilation at 1:50,000 and with 100-foot contours was derived. The theoretical expression was in fairly close agreement with an empirical formula developed at the Air Force Avionics Laboratory, Wright-Patterson Air Force Base, Ohio. The present technology-limited illumination threshold was calculated. Report concludes: (a) Present-day technology would permit the design and development of a twilight photographic system capable of taking photographs 30 minutes after sunset or before sunrise, (b) a practical moonlight photographic system would require that the present technology-limited illumination threshold be reduced by a factor of 40, and (c) a new film-developing process now under test may lower the illumination threshold by a factor of 10. Author (TAB)

N67-16230# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
GUIDING DEVICE FOR COLLECTOR OF CHROMATOGRAPHIC COLUMN ELUATE [PRZYSTAWKA STERUJACA KOLEKTOR FRAKCJI WYCIEKU Z KOLUMNY CHROMATOGRAFICZNEJ]
W. Makarski and J. Rojek *In its* Nukleonika, Vol. VIII 1966 p 82-83 (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The guiding device permits the volume of eluate collected to be regulated over a range from 1 to 10 drops, that is, from some 0.02 to 0.2 ml, and at the same time registers the total number of drops coming out. Because of its simplicity it is inexpensive, easy to make, and reliable in operation. It can be used in laboratory work in adsorption chromatography, separation, and ion-exchange chromatography, especially in isotope laboratories where small volumes of solutions are used. Author

N67-16231# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
THE MGG-1 LIQUID DENSITY METER [MIERNIK GESTOSCI CIECZY MGG-1]
L. Gasiorowski, Z. Paryski, A. Szpecht, and H. Wawrzyszczuk *In its* Nukleonika, Vol. VIII 1966 p 84-85 (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

Technical specifications are listed for the meter which is used for contactless continuous measurement of slight density variations in liquids in industrial pipelines. The operating principle is based on absorption of gamma radiation from the radionuclide Cs-137. The source is in a working container mounted on the pipeline opposite a radiation detector holding four Geiger-Muller counters and a preamplifier. The meter can also be used to measure the volumetric weights of bulk materials. Author

N67-16236# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
AN INDUSTRIAL GAMMA RATEMETER [TRANZYSTOROWY PRZEKAZNIK IZOTOPOWY MST-2]
J. Kalisz *In its* Nukleonika, Vol. VIII 1966 p 131-135 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The circuitry, technical specifications, construction, and industrial applications of a transistorized gamma rate meter are described. Block and schematic diagrams of the circuitry are included. R.N.A.

N67-16237# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
PULSE-HEIGHT RATIO ANALYZER WITH A LOGARITHMIC CHARACTERISTIC [LOGARYTMICZNY ANALIZATOR STOSUNKU AMPLITUD DWU IMPULSOW]
R. Bayer *In its* Nukleonika, Vol. VIII 1966 p 136-138 (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The operating principle and technical specifications of a pulse height ratio analyzer are described. The instrument segregates the ratio of two pulses which arrive at its input at the same instant. It has a logarithmic characteristic and can analyze ratios greater than unity. The upper limit of the ratio is set at five. The instrument works together with a time analyzer and uses the latter's address and arithmetic circuits. A schematic diagram of the instrument's circuit is included. R.N.A.

N67-16244# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
AUTOMATIC RECORDING APPARATUS FOR INVESTIGATION OF THE KINETICS AND MECHANISM OF THE GAS-CONDENSED PHASE REACTION [APARATURA DO BADANIA KINETYKI I MECHANIZMU REAKCVI: GAZ-FAZA SKONDENSOWANA Z AUTOMATYCZNA REJESTRACJA]

J. Zienkiewicz *In its* Nukleonika, Vol. III 1966 p 184–187 ref (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

During research work on chlorination of metallic compounds, a radiometric method was developed for the investigation, under given conditions, of processes which occur between the gas phase labeled with a radioisotope and the condensed phase. The design of the apparatus has been gradually altered and the apparatus described is of a general character and can therefore be of broader application. Author

N67-16247# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

LSU-2 UNIVERSAL SCINTILLATION COUNTER [LICZNIK SCYNTYLACYJNY UNIWERSALNY LSU-2]

W. Scharf *In its* Nukleonika, Vol. VIII 1966 p 196–197 (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The construction and technical specifications for a scintillation counter are described. The counter is used for laboratory measurements of alpha, beta, and gamma radiation with and without windows. R.N.A.

N67-16269# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

LOW-LEVEL PULSE HEIGHT DISCRIMINATOR [NISKOPOZIOMOWY DYSKRYMINATOR AMPLITUDY IMPULSOW]

A. Zastawny *In its* Nukleonika, Vol. VIII 1966 p 317–326 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The applicability was investigated of a circuit concept suggested to satisfy the requirements set for electronic instruments used together with a ^{14}C proportional counter for geochronometrical measurements. A diagram of the experimental circuit is presented, and the switching pulse shape and operating conditions of the circuit are considered. It is concluded that this circuit design is suitable for pulse frequencies which do not exceed 10^4 sec^{-1}. A.G.O.

N67-16278# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

RADIOISOTOPIC GAUGE FOR MEASURING THE WATER LEVEL IN DEEP WELLS [RADIOIZOTOPOWY MIERNIK POZIOMU ZWIERCIADLA WODY W STUDNIACH GLEBINOWYCH]

K. Korbel and J. Lasa *In its* Nukleonika, Vol. VIII 1966 p 396–399 ref (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

A communication which cites the development, operating principles, and technical specifications of a radioisotopic gauge for measuring the water level in deep wells, is reported. S.C.W.

N67-16286# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

SOURCES OF INSTABILITY IN THE WORK G-M END WINDOW COUNTERS [ZRODLA NIESTABILNOSCI PRACY OKIENKOWYCH LICZNIKOW G-M]

K. W. Ostrowski *In its* Nukleonika, Vol. VIII 1966 p 466–472 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

Some practical notes on the various difficulties and instability related to the use of window G-M counters are reviewed. General observations are presented on the complications of counter operation to photosensitivity, stabilized operating threshold, aluminum or lead cathode counters, and the lifetime of end window counters. The principal causes of disturbances in counter operation are arranged schematically in a table. It is stated that most of the observations listed also apply to other types of counters quenched with vapors of organic compounds. R.Li.

N67-16293# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

SINGLE-CHANNEL PULSE-HEIGHT ANALYZER WITH FIXED DELAY OF OUTPUT [JEDNOKANALOWY ANALIZATOR AMPLITUDY ZE STALYM OPOZNIENIEM]

M. Nadachowski *In its* Nukleonika, Vol. VIII 1966 p 593–584 (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The instrument serves to select pulses of a height contained in an interval determined by a set threshold and window width. Differential and integral spectra of pulse heights can be registered with it. Due to a fixed delay of the output pulse in relation to the front of the analyzed pulse the analyzer can be used in spectrometric systems operating on the principle of fast-slow coincidences. Author

N67-16302# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

EQUIDENSITOGRAPH FOR AUTORADIOGRAPHY [EKWIDENSYTOGRAF DO AUTORADIOGRAMOW]

A. Jankowski *In its* Nukleonika, Vol. VIII 1966 p 593–594 (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The equidensitograph design for obtaining the radioactive isotope concentration in alloy samples is briefly described. The method yields curves connecting the points on the autoradiogram with the same blackening. A diagram illustrating the operating principle is included. N.E.N.

N67-16308# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

A LOW-BACKGROUND BETA SCINTILLATION COUNTING METHOD

Z. Jaworowski *In its* Nukleonika, Vol. VIII 1966 p 631–635 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

For measurements of minute beta activities a scintillating counter was used, whose mean background counts were 0.44 c.p.m. The low background pulses were obtained without applying the anticoincidence system, by using a detector constructed from scintillating plastic foil 0.3 mm thick. Author

N67-16310# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

256-CHANNEL TIME-OF-FLIGHT ANALYZER WITH MAGNETIC MEMORY [256-KANALOWY ANALIZATOR ROZKLADU CZASOWEGO IMPULSOW Z PAMIECIA MAGNETYCZNA]

Z. Hoffman, Z. Komar, and A. Sawicki *In its* Nukleonika, Vol. VIII 1966 p 643–655 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The instrument is built on the basis of digital computer techniques and consists of some blocks such as magnetic memory, address register, arithmetic unit, and data printer. The instrument was designed to measure the time of flight of neutrons, the method generally employed in neutron spectrometry. Author

N67-16311# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

THE INFLUENCE OF THE ANALYZER CHANNEL WIDTH ON THE SHAPE OF THE PHOTOPEAK OF A MONOENERGETIC GAMMA LINE

S. Sterlinski *In its* Nukleonika, Vol. VIII 1966 p 656–659 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

Equations are formulated to show how the values of the experimental peak can be represented by the Gaussian curve. With the aid of the analyzer, the width of its channel being l, a portion of the curve (a number of impulses) is chosen out of the range x,x+l, with x being the position of an impulse on the energetic scale of the spectrum. The dependence of the experimental peak on various values is plotted. M.G.J.

N67-16394# Mound Lab., Miamisburg, Ohio.
A NEUTRON SPECTROMETER UTILIZING THE PRINCIPLE OF CHARGED PARTICLE COLLIMATION
Richard A. Wolfe and Warren Fenton Stubbins 21 Sep. 1966 39 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1339) CFSTI: HC $3.00/MF $0.65

Two different experimental neutron spectrometers were developed using the principle charged-particle collimation to improve the resolution in neutron detection. The thick spectrometer containing a 1.02×10^{-2} cm thick ^{6}Li metal target and two copper collimators showed the neutron energy resolution of approximately 170 KeV or 1.5 percent when detecting 14.7 MeV neutrons. The thin spectrometer containing a 6.0×10^{-5} cm thick ^{6}LiF target and a single collimator was tested with thermal neutrons. Measurements with the thin spectrometer established that the copper collimator significantly improved the energy resolution of thermal neutron detection by about 30 percent. The spectrometers were maintained under a vacuum during all the measurements to prevent oxidation of the lithium metal and to eliminate the energy loss of the charged particles due to collision with gas while traversing the collimators. The experiments revealed that an arrangement which separated the two surface barrier detectors by a finite distance was equivalent to charged-particle collimation and provided an alternate means of improving the energy resolution of neutron spectrometers. Author (NSA)

N67-16412# Marine Engineering Lab., Annapolis, Md.
SIGNAL CONDITIONING BOX FOR ANTISUBMARINE WARFARE MAGNETOMETER SYSTEMS
Alan S. Fields Nov. 1966 36 p
(MEL-TM-164/66; AD-642027) CFSTI: HC $3.00/MF $0.65

A signal conditioning device was designed and built to scale, power amplify, and filter a multiplicity of signals for the antisubmarine warfare magnetometer systems project. The memorandum may serve as a users and maintenance manual. Author (TAB)

N67-16427# General Electric Co., Schenectady, N. Y. Research and Development Center.
ELECTRON-TIME-OF-FLIGHT SPECTROMETER Final Technical Report
G. C. Baldwin and S. I. Friedman 1 Oct. 1966 54 p refs
(Contract Nonr-3942(00); ARPA Order 125)
(AD-641394) CFSTI: HC $3.00/MF $0.65

A velocity selector is described which is designed for measurement of the total collision cross section of electrons in the energy region below one volt. The system determines the distributions of times of flight of single electrons over a measured path at selected pressures of a specimen gas. The electrons are generated by repetitive illumination of a photo-emitter by a spark gap, pass over a shielded drift path, enter an accelerating field, and impinge on an electron multiplier. Electronic equipment and data reduction for analysis of time-of-flight and amplitude distributions of electron counts are described; data illustrative of performance are presented, including typical transmission measurements in helium and argon which extend to 100 millivolts. Applications and extensions of the technique are discussed. Author (TAB)

N67-16448# Naval Training Device Center, Port Washington, N. Y.
RESEARCH AND DEVELOPMENT OF A SIMULATED DOSIMETER (FOR USE IN CONJUNCTION WITH LARGE AREA RADIAC TRAINER, DEVICE 11F6) Final Report, Dec. 1965–Jun. 1966
Michael R. Leibowitz Sep. 1966 38 p refs
(NAVTRADEVCEN-IH-61; AD-641182) CFSTI: HC $3.00/MF $0.65

The simulated dosimeter must resemble and perform like the actual Dosimeter (IM-93/UD) except that its motivation must be radio waves rather than radioactivity. The approach taken was to modify the actual IM-93/UD dosimeter by bringing a conduction lead to the inner charged foil. The charge was bled off through the plate of an electrometer tube, the bleed off being controlled by grid bias. An electrometer tube had to be used since other types of tubes allowed too much spurious conduction. Observations are given on phenomenon in the picoampere range. Author (TAB)

N67-16678*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EVALUATION OF A THIN-FILM, HEAT FLUX PROBE FOR MEASURING GAS VELOCITIES IN AN UNSTABLE ROCKET COMBUSTOR
Frederick P. Povinelli and Robert D. Ingebo Washington, NASA, Feb. 1967 25 p refs
(NASA-TM-X-1333) CFSTI: HC $3.00/MF $0.65 CSCL 21B

The use of a heat-flux probe to measure gas velocities in an unstable rocket combustor was evaluated. The combustor burned ethanol and liquid oxygen at an oxidant- to fuel-mass ratio of 0.9 at an average chamber pressure of 178±2 pounds per square inch absolute. Measurements were made of heat transfer from combustion gases to a water-cooled, thin-film sensor. Gas velocities calculated from the heat-transfer data were generally more than a factor of two larger than velocities measured from streak photographs. A correction applied to the heat-flux signal resulted in better agreement. Maximum streak velocities and maximum velocities calculated from pressure measurements agreed to within 3 percent. Author

N67-16683* National Aeronautics and Space Administration, Washington, D. C.
ON A NEW NONMAGNETIC DYNAMIC MASS SPECTROMETER [UBER EIN NEUES MAGNETLOSES DYNAMISCHES MASSENSPEKTROMETER]
M. J. Higatsberger, F. Ruedenauer, and F. Viehboeck Nov. 1966 12 p refs Transl. into ENGLISH from GERMAN
(NASA-TT-F-10465) CFSTI: HC $3.00 CSCL 14B

A novel nonmagnetic mass spectrometer similar to the Bennet type with HF fields and drift spaces is described, in which energy selection is obtained by parabolic particle trajectories, yielding a sharp energy resolution. Quantitative relations for the energy gain of the system, with data on the design of the prototype, are given. The results of preliminary measurements yielded satisfactory agreement with the theory. Author

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N67-15392# Joint Publications Research Service, Washington, D. C.
SEAMLESS TUBE PRODUCTION
Yu. M. Matveyev 30 Dec. 1966 93 p refs Transl. into ENGLISH of Chap. II from the book "Proizvodstvo Svarnykh i Besshovnykh Trub" Moscow, Metallurgiya Press, No. 5, 1965 refs
(JPRS-39345; TT-66-35767)

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N67-15393# Joint Publications Research Service, Washington, D. C.

PIERCING WITH FORCED FEED OF BILLET

Ya. S. Finkel'shteyn *In its* Seamless Tube Production 30 Dec. 1966 p 1–25 refs (See N67-15392 06-15)

Equations are developed for analyzing the conditions of force equilibrium in the deformation zone, taking into account the direction of friction forces. The process kinematics are evaluated from an analysis of the axial slip factor. A method is suggested for studying the dynamics of the piercing process, and the force feed conditions, and power and roll power are determined. Coefficients characterizing the force and energy conditions of piercing with forced feed are proposed and discussed. N.E.N.

N67-15394# Joint Publications Research Service, Washington, D. C.

WAYS OF INCREASING PRODUCTIVITY OF TUBE ROLLING INSTALLATIONS WITH AUTOMATIC MILL

Ya. S. Finkel'shteyn, M. G. Berdyanskiy, I. M. Brodskiy, and I. Z. Khodak *In its* Seamless Tube Production 30 Dec. 1966 p 26–38 refs (See N67-15392 06-15)

The main trends in improving the productivity of piercing and rolling mills in tube-rolling installations are reveiwed. Ways of intensifying the piercing process and of shortening the time for the support operations are discussed. The speed and inclination of the rolls, and the automatic feeding of the billets are described. It was found that increasing the roll inclination along with increasing the piercing speed reduces the tendency to axial failure and aids in improving the quality of the inner surface of the casings. On the other hand, increasing the peripheral speed of the rolls increases the tendency to axial failure and deteriorates the quality of the surface. N.E.N.

N67-15395# Joint Publications Research Service, Washington, D. C.

ANALYTIC METHOD OF FINDING AREA OF METAL-ROLL CONTACT SURFACE IN TRANSVERSE-HELICAL ROLLS

Yu. M. Matveyev, F. M. Bykov, and Ya. S. Finkel'shteyn *In its* Seamless Tube Production 30 Dec. 1966 p 39–48 refs (See N67-15392 06-15)

An analytical study of the contact surface on mushroom-shaped rolls is presented. Equations are developed for rolling a billet into a solid body and into a hollow casing. The relations can be used for computing the energy and force parameters and for studying the transverse-helical rolling process. N.E.N.

N67-15396# Joint Publications Research Service, Washington, D. C.

STRESS STATE OF BILLET (SHELL) IN MILL WITH OFFSET AXIS

P. I. Polukhin, Yu. M. Matveyev, R. M. Golubchik, V. K. Vorontsov, L. I. Zayonshik et al *In its* Seamless Tube Production 30 Dec. 1966 p 49–66 refs (See N67-15392 06-15)

The dependence of the stress state on the magnitude of the axis offset relative to the mill axis is studied with an optical polarization technique and a mathematical analysis is presented. Diagrams of isochrome patterns and of contour stresses are included and annular fracture is discussed. It was concluded that the piercing process with billet axis offset relative to the mill axis reduces the probability of forming a cavity at the billet's center, and that for hollow bodies, offset of the tube axis reduces the probability of the occurrence of surface defects. N.E.N.

N67-15397# Joint Publications Research Service, Washington, D. C.

METALLOGRAPHIC STUDY OF NATURE OF DEFORMATION AND FRACTURE IN TRANSVERSE-HELICAL ROLLING

Ya. S. Finkel'shteyn, A. Z. Gleyberg, V. N. Kukarskikh, R. I. Chemerinskaya, L. A. Salyuk et al *In its* Seamless Tube Production 30 Dec. 1966 p 67–74 refs (See N67-15392 06-15)

Metallographic studies of fracture in the cross section and in the central zone of a billet are reported for various combinations of plastic deformation, heating temperatures, and initial microstructure of the rolled metal. The presence of carbides, the alpha phase, and the roll axis inclination are discussed. Among the conclusions are that increasing the content of the alpha phase and carbide inclusions reduces the plastic properties, that the deformation across the billet is not a function of temperature, and that the nature of deformation distribution varies as a function of the average partial reductions. N.E.N.

N67-15398# Joint Publications Research Service, Washington, D. C.

ANALYSIS OF BASIC PROCESSES OF TUBE ROLLING USING LONG MANDREL

V. N. Vydrin and A. G. Novikov *In its* Seamless Tube Production 30 Dec. 1966 p 75–84 refs (See N67-15392 06-15)

The effects of a long mandrel on tube reduction and on continuous rolling and drawing are described. Expressions are developed for mandrel action with respect to power, and for mandrel velocity under the action of external forces. Advantage of driving the mandrel in the rolling direction rather than having it freely floating and pilger mill tube rolling are discussed. N.E.N.

N67-15503 Argentina. Comision Nacional de Energia Atomica, Buenos Aires.

FABRICATION OF POROUS PLATES [FABRICACION DE PLACAS POROSAS]

Luis A. Boschi *In its* 1st Latin Am. Conf. on Process Met. and Metal Working, Vol. II Aug. 1966 12 p In SPANISH; ENGLISH summary (See N67-15501 06-17) CFSTI: HC $3.00/MF $0.65

For industrial safety applications, the fabrication of porous plate filters made by direct sintering of bronze powder, without previous pressing. The filter is capable of filtering one liter a minute with an entrance pressure of only 0.5 atm. Other properties mentioned are: non-absorbency, bursting pressure, and microstructure. A reducing atmosphere produced by bubbling natural gas through methanol is also described. Transl. by R.Ll.

N67-15504 Cordoba National Univ. (Argentina).
A NEW THEORY TO CALCULATE FORCES IN METAL FORMING OPERATIONS
Eduardo R. Abril *In* Arg. Comision Nacl. de Energia Atomica 1st Latin Am. Conf. on Process Met. and Metal Working, Vol. II Aug. 1966 22 p refs In SPANISH; ENGLISH summary (See N67-15501 06-17) CFSTI: HC $3.00/MF $0.65

A thermodynamic criterion was applied to the problem of assessing force and strength in plastic deformation metal working operations. The theory assumes that work between initial and final state depends only on these states unless redundant (or friction) work is performed. A formula is devised to calculate accurately the value of the force required in wire drawing operations. Quantitative results are derived in comparison with the type of lubrication as well as the form and finish of the wire used. Experiments to check the validity of these calculations yielded results indicating that the calculated forces are in better agreement with the measured forces than those calculated with previously proposed formulas. Transl. by R.Ll.

N67-15505 Argentina. Comision Nacional de Energia Atomica, Buenos Aires.
FIRE-REFINING PROCESS AND OTHER SOLUTIONS TO PROBLEMS ARISEN FROM IMPURITIES IN α Cu AND BRASS [REFINACION A FUEGO Y OTRAS SOLUCIONES PARA LOS PROBLEMAS PRESENTADOS POR LA PRESENCIA DE IMPUREZAS EN COBRE Y LATONES ALFA]
H. J. Destaillats, E. Gerarduzzi, and R. A. Morando *In its* 1st Latin Am. Conf. on Process Met. and Metal Working, Vol. II Aug. 1966 13 p refs In SPANISH; ENGLISH summary (See N67-15501 06-17) CFSTI: HC $3.00/MF $0.65

For refining copper of high impurity content (scrap), techniques were devised to fire-refine copper and to eliminate hot shortness produced by lead in copper and brass. The use of chlorine gas in conjunction with the common oxidizing method is proposed to eliminate impurities. Experimental tests show the advantage of this method for small or medium size plants. The effect of adding uranium to alpha brass containing lead, in order to neutralize its damaging effects during hot-rolling, is also presented. Transl. by R.Ll.

N67-15506 Instituto de Pesquisas Tecnologicas, Sao Paulo (Brazil).
DETERMINATION OF RESIDUAL PROPERTIES OF FOUNDRY SANDS [ESTUDO SOBRE A DETERMINACAO DE ALGUMAS CARACTERISTICAS RESIDUAIS DAS AREIAS DE MOLDAGEM]
Victor Lo Re *In* Arg. Comision Nacl. de Energia Atomica 1st Latin Am. Conf. on Process Met. and Metal Working, Vol. II Aug. 1966 18 p refs In PORTUGUESE; ENGLISH summary (See N67-15501 06-17) CFSTI: HC $3.00/MF $0.65

The feasibility is considered of a test method to determine some residual characteristics of molding sand after it has been in contact with liquid metal. Conducted in the test matrix, this procedure helps to explain the behavior of sand while it is being filled into the mold. Values obtained for residual resistance permit a correlation to be established on collapse properties and a comparison to be made with results obtained in high temperature testing with the dilatometer. Results obtained are considered useful in the control of agglomerants and additives to molding sands for foundry purposes. Transl. by R.Ll.

N67-15507 California Univ., Berkeley.
SOME ASPECTS OF METAL PROCESSING
Erich G. Thomsen *In* Arg. Comision Nacl. de Energia Atomica 1st Latin Am. Conf. on Process Met. and Metal Working, Vol. II Aug. 1966 18 p (See N67-15501 06-17) CFSTI: HC $3.00/MF $0.65

To select the most suitable and economic process and material for a given industrial application, the forming characteristics and the state of stress in metal processing is investigated. A classification of the principal metal forming processes is presented, and several methods of obtaining approximate solutions to plastic deformation in forming problems discussed. A careful examination of the energy equation is made and every term in the equation accounted for in the treatment of forming problems. It is suggested that in practice the prediction of forces and energy alone is not sufficient and more thought must be given to the possibility of mechanical properties, surface finish, and forming defects. Author

N67-15508 Army Materials Research Agency, Watertown, Mass.
TRI-SERVICE COORDINATED METAL WORKING AND PROCESSING PROGRAM
Norman L. Reed *In* Arg. Comision Nacl. de Energia Atomica 1st Latin Am. Conf. on Process Met. and Metal Working, Vol. II Aug. 1966 18 p refs (See N67-15501 06-17) CFSTI: HC $3.00/MF $0.65

To assess research information on metal deformation, devise and promote improved metal processing equipment, and recommend processing of the variety of metals required by the Department of Defense, a coordinated program was devised. Effort was directed toward: a compilation of deformation characteristics imposed by various processes, recommendation of programs to overcome the information gap, and design of new metal working equipment. Other summarized reports cover: application of ultrasonic energy in metal deformation, and application of high pressure in metal-deformation processing. R.Ll.

N67-15509 Bureau of Naval Weapons, Washington, D. C.
SOME TECHNICAL ASPECTS OF THE U.S. METALWORKING PROCESSES AND EQUIPMENT PROGRAM
N. E. Promisel *In* Arg. Comision Nacl. de Energia Atomica 1st Latin Am. Conf. on Process Met. and Metal Working, Vol. II Aug. 1966 14 p (See N67-15501 06-17) CFSTI: HC $3.00/MF $0.65

The U.S. Metalworking Processes and Equipment Program is presented and some specific examples given of phenomena and metal behavior to be considered in new techniques and equipment. The program's basic objectives are to develop techniques and equipment adjusted to the characteristic behavior of the material, and to examine deformation properties to be considered in equipment design and processing methods. New techniques are required for: reduction in forming and friction forces by application of ultrasonic vibration; increasing ductility by applying high hydrostatic pressure; fluid to fluid extrusion to reduce friction forces and hoop stresses in dies; control of texture to improve formability; and, utilization of superplastic conditions to improve formability. R.Ll.

N67-15510 Army Materials Research Agency, Watertown, Mass.
MATERIALS RESEARCH IN SUPPORT OF ADVANCED TECHNOLOGY
S. Valencia and P. A. G. Carbonaro *In* Arg. Comision Nacl. de Energia Atomica 1st Latin Am. Conf. on Process Met. and Metal Working, Vol. II Aug. 1966 41 p refs (See N67-15501 06-17) CFSTI: HC $3.00/MF $0.65

To develop optimum materials and economically produce military weaponry, a materials research program is described. Technical details are given on: dendritic growth and segregation during solidification to provide basis for advanced casting techniques for improving structural homogeneity; precision forming to provide a method for internal contouring of tubular shapes; solid state bonding of hard-to-fuse weld materials; application of high-energy rate to metal forming; and, the removal of metal at high velocity by using advanced ceramic cutting tool materials. Applications and economic benefits from the research described are mentioned. R.Ll.

N67-15511 Instituto de Pesquisas Tecnologicas, Sao Paulo (Brazil).

PRODUCTION OF COPPER–COBALT–SILICON ROTATING SEAM-WELDING ELECTRODES [A PRODUCAO DE ELETRODES GIRANTES PARA SOLDAGEM EM LIGA COBRE–COBALTO–SILICIO]

Sergio Augusto de Souza and Luiz C. Correa da Silva *In* Arg. Comision Nacl. de Energia Atomica 1st Latin Am. Conf. on Process Met. and Metal Working, Vol. II Aug. 1966 12 p refs In PORTUGUESE; ENGLISH summary Presented at the Brazilian Metal Assoc. 19th Ann. Congr., Sao Paulo, Jul. 1964 (See N67-15501 06-17) CFSTI: HC $3.00/MF $0.65

Copper–cobalt–silicon rotating seam-welding electrodes were developed for soldering machines in order to reduce dependence on imports. Techniques were devised to cast rings of optimum dimensions for subsequent forging, to forge rings in final shape, and to heat treat them to the required hardness (up to 200 BHN). Macro- and micrographs illustrate the structure of heat-treated electrodes. Transl. by R.Ll.

N67-15513 Battelle Memorial Inst., Columbus, Ohio.

NONFERROUS METAL SHEET MANUFACTURING

F. R. Morral *In* Arg. Comision Nacl. de Energia Atomica 1st Latin Am. Conf. on Process Met. and Metal Working, Vol. II Aug. 1966 14 p refs (See N67-15501 06-17) CFSTI: HC $3.00/MF $0.65

The metallurgical characteristics and mechanical properties of nonferrous metal sheets are discussed. Manufacturing techniques surveyed for producing sheet are: semicontinuous casting, casting of thin slabs, and powder metallurgy. Technical details are given on these techniques and related processes in manufacturing sheet from common metals and alloys, and from unusual metallic materials. Sheet processing costs were estimated at about $.10 per lb for a 50-ton/day plant making various grades of stainless steel, and $.25 per lb for a 10-ton/day plant turning out specialty alloys. R.Ll.

N67-15514 Lockheed Missiles and Space Co., Sunnyvale, Calif.

DESIGN OPTIMIZATION THROUGH MATERIALS RESEARCH

M. A. Steinberg *In* Arg. Comision Nacl. de Energia Atomica 1st Latin Am. Conf. on Process Met. and Metal Working, Vol. II Aug. 1966 36 p refs (See N67-15501 06-17) CFSTI: HC $3.00/MF $0.65

Materials developed with specific properties or combination of properties to meet the light-weight and high-temperature structural requirements of advanced missile and spacecraft technology are examined. General design and system concepts for determining actual materials research and development are discussed. Both absortive and radiative system approaches to the design of thermal protection systems for reentry bodies are examined, and materials specifications listed. A composite based on inorganic bonding of various refractory fibers for thermal protection systems is considered, and problems relating to coated refractory metals analyzed. A parametric analysis of component and materials capabilities against mission requirements for a rocket motor case is described, and a comparison made of steel, titanium, and glass-filament wound cases. Other materials developed with specific properties for aerospace requirements are beryllium–aluminum alloys with a good combination of modulus, strength, ductility, and weight. R.Ll.

N67-15515 Colorado School of Mines, Golden.

EXPLOSIVE WORKING OF METALS

John S. Rinehart *In* Arg. Comision Nacl. de Energia Atomica 1st Latin Am. Conf. on Process Met. and Metal Working, Vol. II Aug. 1966 19 p (See N67-15501 06-17) CFSTI: HC $3.00/MF $0.65

Techniques for explosively working metals, drawing, forming, swedging, welding, and cutting metals are surveyed. Composition of explosive are listed for both low explosives or propellants, and high explosives. Processes most effectively and wide adopted are: (1) those in which the process can be done only by utilizing the exotic and extreme conditions generated by explosives (e.g., work hardening of manganese steel, compaction of metal powders, or the production or re-entrant contours); and (2) those in which the working of the metal could be accomplished by other means but only at excessive expenditure of time, effort, and money (e.g., sizing of missile noses, or production of a railroad tank car). Explosive forming of a few production parts is relatively inexpensive and simple since the dies and tanks required are relatively easy to fabricate. Another advantage cited of the explosive-forming technique is that it requires relatively little capital outlay. R.Ll.

N67-15516 Battelle Memorial Inst., Columbus, Ohio.

NEW METAL MANUFACTURING PROCESSES IN THE U.S.A. OF POSSIBLE APPLICATION IN LATIN AMERICAN COUNTRIES

F. R. Morral *In* Arg. Comision Nacl. de Energia Atomica 1st Latin Am. Conf. on Process Met. and Metal Working, Vol. II Aug. 1966 32 p refs (See N67-15501 06-17) CFSTI: HC $3.00/MF $0.65

An evaluation of the economics of new and old manufacturing techniques used in the metallurgical industry is presented. Increased productivity from small-scale manufacturing processes in Latin American countries is the focal point, and problem areas posed include heavy capital investment by small firms, the unavailability of qualified scientists and engineers, as well as economic factors of profit level and liquidity. A bibliography and extensive technical data cover: steel mill costs, steelmaking and remelting of sponge iron, continuous casting, controlled pressure pouring, Properzi system for rod and wire, heat treating, machining, and powder metallurgy. R.Ll.

N67-15517 CAMEA S.A., Buenos Aires (Argentina).

CONTINUOUS CASTING OF ALUMINUM [COLADA CONTINUA DE ALUMINIO]

Juan Luis Ciarlo and Roland Meillat *In* Arg. Comision Nacl. de Energia Atomica 1st Latin Am. Conf. on Process Met. and Metal Working, Vol. II Aug. 1966 19 p refs In SPANISH; ENGLISH summary (See N67-15501 06-17) CFSTI: HC $3.00/MF $0.65

Quality control and component reliability in the development of a Properzi continuous casting system for aluminum is assessed. The system described includes tilting furnace, water cooled casting wheel, rod rolling trains and rod coiling devices. Application of the rod in the manufacture of power transmission lines is noted. Transl. by R.Ll.

N67-15518 Argentina. Comision Nacl. de Energia Atomica, Buenos Aires.

ROLL-BONDING OF METALS [ESTUDIO DE LA COLAMINACION DE METALES]

J. Almagro, G. Cusminsky, and C. Martinez Vidal *In its* 1st Latin Am. Conf. on Process Met. and Metal Working, Vol. II Aug. 1966 10 p refs In SPANISH; ENGLISH summary (See N67-15501 06-17) CFSTI: HC $3.00/MF $0.65

Both hot and cold bond-rolling techniques for metal hardening developed at the Argentine National Atomic Energy Committee are described. Joining metal by solid-state brazing methods is noted, and it is considered that for the bond-rolling techniques indicated, the formation of weak oxides is preferable to those formed after deformation. Basic metal working mechanisms were investigated and important parameters derived for industrial production. Pilot plant experiments confirmed the validity of the predictions, and the method is now being used to produce the fuel elements for the first Argentine experimental and isotope production reactor. Transl. by R.Ll.

N67-15544# Picker X-Ray Corp., Cleveland, Ohio. Value Assurance Dept.
RADIOGRAPHY
E. W. Coleman *In* Du Pont Large Scale Production and Appl. of Radioisotopes May 1966 2 p (See N67-15525 06-22) CFSTI: HC $3.00/MF $0.65

Two examples of recent developments in isotopic radiography for industrial application are presented. A set of specially made castings with known defects were radiographed with million-volt X-rays, betatrons, and ^{60}Co. After studying these radiographs, it was concluded that results obtainable with a properly collimated cobalt-60 source are as good as, and in the case of some types of casting defects, better than those attainable with a betatron. In another radiography application, a very high specific activity 170Tm source of less than 1 mm focal spot size was developed. The radiographic results attainable on thin-walled stainless under these conditions are considered excellent, and the method was accepted. R.L.I.

N67-15679*# Hughes Aircraft Co., Culver City, Calif. Materials Technology Dept.
STUDY OF SPACE ENVIRONMENT FABRICATION AND REPAIR TECHNIQUES Final Technical Summary Report
R. D. Engquist and D. B. Nord Dec. 1966 114 p refs
(Contract NAS9-4548)
(NASA-CR-65568; P66-275; A6439) CFSTI: HC $3.00/MF $0.65 CSCL 13H

The objective of this program was to study a broad spectrum of joining techniques which might be suitable for fabrication and repair of structures in an extraterrestrial environment, select the two most promising methods, and perform a feasibility demonstration test. Electron beam welding and resistance welding/brazing/soldering were the two methods selected for feasibility demonstration and test. While both are feasible, neither is universally applicable to all fabrication and repair requirements. Tests have shown that electron beam welding will be an excellent method of joining 6AL-4V-titanium to self and Inconel 718 to self, a poor method of joining AZ31B magnesium to self, impractical for joining 2014 aluminum to self because of the tooling required to prevent buckling of the thin gauges, and a very poor method of joining 6AL-4V-titanium to Inconel 718. Resistance soldering techniques appear feasible for all of the materials combinations. Quantitative engineering data concerning the strength hermeticity, and reliability of joints in typical materials and gauge thicknesses have been obtained. In addition the effort has identified certain problems related to joint design, tolerances and metallurgical compatibility. Author

N67-15813*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A DEFINITION OF SYSTEM RELIABILITY
J. F. Meyer *In its* Space Programs Sum. No. 37-40, Vol. 4 31 A[illegible] 1966 p 154–163 (See N67-15781 06-34) CFSTI: HC $3.[illegible]/MF $0.65

A measure of system reliability is discussed that accounts not only for total success but also for the various degrees of partial success that a system might experience in realizing its specified behavior. The system itself is defined in terms of attributes that influence its reliability. The system then forms a base for developing such concepts as performance and utility. These concepts are used to define system reliability. The latter part of the discussion is devoted to specializations that correspond to certain physically motivated constraints. Author

N67-15936# Lockheed Missiles and Space Co., Palo Alto, Calif.
INVESTIGATION OF THE DEFORMATION OF A HORIZONTALLY DISPOSED CYLINDER AND ITS CONNECTION WITH CREEP OF THE MATERIAL
I. S. Kainarskii and I. G. Orlova [1966] 7 p refs Transl. into ENGLISH from Neorganich. Materialy (USSR), v. 2; no. 7, 1966 p 1285–1290

In investigating the deformation kinetics of refractory materials, the instrument used was based on the principle of the deflection of a horizontal beam resting on two supports. With this technique, the deflection of the sample in the furnace was transmitted to the measuring apparatus by the end of a platinum wire hanging from the middle of the sample. Supports for the sample were compactly baked corundum rods. A microscope was used to observe the displacement of the wire during the temperature rises and isothermal holding in the tests. Also considered was the interrelationship between the tendency of the material to be deformed and the deformation of a specific geometric shape. A furnace with a platinum–rhodium winding was constructed for this purpose. It was found that the change in cylinder ellipticity during sintering (which occurs due to its own weight) as a function of the temperature and holding time corresponds to the temperature and kinetic curves of beam deformation under its own weight. M.G.J.

N67-16042*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
STUDIES OF LOW AND HIGH TEMPERATURE CAGE MATERIALS
E. V. Zaretsky, H. W. Scibbe, and D. E. Brewe Washington, NASA, 1967 31 p refs To be presented at the Spring Lubrication Conf., Miami Beach, Fla., 5–7 Jun. 1967; Sponsored by ASME
(NASA-TM-X-52262) CFSTI: HC $3.00/MF $0.65 CSCL 13H

Seven self-lubricating retainer materials were evaluated in 40-millimeter-bore ball bearings operating in a 60° R hydrogen gas at 20,000 rpm and with a 200-pound thrust load. The relative wear of six high-temperature bearing cage materials was also determined at 500° and 700° F in a nitrogen-blanketed cage compatibility tester. When used as cages, glass-fiber-filled and bronze-filled polytetrafluoroethylene (PTFE) materials provided transfer films on the bearing inner-races for test durations exceeding 10 hours without evidence of race wear at the cryogenic temperature. Minimum cage wear was obtained at cryogenic temperature with the laminated-glass cloth PTFE and the filled PTFE materials. At the elevated temperatures, S-Monel and AISI M-1 materials gave least wear. For these materials wear decreased with increasing material hardness. Author

N67-16048*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THE EFFECT OF THE SPACE ENVIRONMENT ON LUBRICANTS AND ROLLING ELEMENT BEARINGS
W. J. Anderson and D. C. Glenn Washington, NASA, 1967 48 p refs To be presented at the Conf. on Lubrication and Wear—Fundamentals and Appl. to Design, London, 25–28 Sep. 1967; Sponsored by Inst. of Mech. Engr.
(NASA-TM-X-52268) CFSTI: HC $3.00/MF $0.65 CSCL 13I

The effects of spatial environmental factors such as the very low ambient pressure and the absence of oxygen on lubrication are discussed. The low pressure causes liquids, and even solids, to boil away so that their vapor pressure and evaporation rates become important. Evaporation experiments with metals, liquids, greases and solid lubricants are discussed. Silicone oils and silicone based greases appear to have the lowest evaporative loss among the fluids investigated. Bearing experiments indicate that liquids and greases, when properly shielded, can provide longer bearing lives than bonded solid lubricants or metal platings. Silicone fluids yield the best bearing life, confirming the results of evaporation tests. Life results with bonded solid films are generally poor. Results are considerably better when the solid lubricant is used as a constituent in a solid-composite material. Bearing reliability in space applications may be a problem because considerable life scatter is observed where a particular lubricant or lubrication technique is evaluated in multiple tests. Life ratios of 10 were common. Author

N67-16060*# Southern Research Inst., Birmingham, Ala.
ADHESIVES, SEALANTS, AND GASKETS–A SURVEY
R. B. Perkins and S. N. Glarum Washington, NASA, 1967 63 p refs Sponsored by NASA
(NASA-SP-5066) GPO: HC $0.25; CFSTI: MF $0.65 CSCL 11A

As part of a technology utilization program to accelerate the dissemination of technical information developed for space missions, a survey is presented on adhesives, sealants, and gaskets developed to operate in the extreme environments encountered in space work. Emphasis is on reliability of materials that can be used in a liquid oxygen environment. Considered to be of special potential interest for industrial use, the following are described: polymeric fillers in adhesives, elastomeric films in glue lines, epoxy ester adhesives, sealants for low-temperature service, gasket design, and measurement of stress in gaskets. R.Li.

N67-16132# Air Force Cambridge Research Labs., Bedford, Mass. Solid State Sciences Lab.
NEW ELECTRON BEAM OPTICS FOR THE PREPARATION OF INSULATING CRYSTALS BY THE FLOATING ZONE METHOD Interim Scientific Report
Charles E. Ryan, Dennis P. Considine, John J. Hawley, and Robert C. Marshall Aug. 1966 27 p refs *Its* Instrumentation Paper No. 110
(AFCRL-66-539; AD-640961) CFSTI: HC $3.00/MF $0.65

The problems involved in the preparation of single crystals of refractory insulating materials are briefly outlined. The current status of the preparation of insulating crystals by the electron beam heated floating-zone method is reviewed, and the disadvantages are noted. The conception, construction and test of a new electron beam optics are described, and the advantages are pointed out. Sapphire, ruby and tungsten rods were zoned in testing the new optics. The influence of zone length, liquid - solid interface geometry, foreheater and afterheater temperature, and mechanical translation and rotation systems on crystal perfection are discussed. Author (TAB)

N67-16174# General Motors Corp., Indianapolis, Ind. Allison Div.
ALLISON RESEARCH AND ENGINEERING, VOLUME NO. 12, FOURTH QUARTER 1966
1966 33 p refs

CONTENTS:

1. TRANSPORT OF CARBON AND NITROGEN FROM STAINLESS STEEL CONTAINING FLOWING POTASSIUM C. L. Walker, R. G. Fox, and S. L. Schrock p 2–7 refs (See N67-16175 06-17)

2. RELIABILITY EVALUATION OF TRANSMISSION GEARS W. E. Schilke p 8–21 refs (See N67-16176 06-15)

N67-16176# General Motors Corp., Indianapolis, Ind. Allison Div.
RELIABILITY EVALUATION OF TRANSMISSION GEARS
W. E. Schilke *In its* Allison Res. and Eng., Vol. 12, Fourth Quarter 1966 p 8–21 refs (See N67-16174 06-15)

Reliability evaluation as it applies to transmission gears is discussed, and emphasis is placed on the pitting fatigue mode of failure. A general form of reliability formula is given, and the various modes of failure in gearing are considered. The loss-of-drive tests are described, and R/S/N curves are presented for loss-of-drive due to pitting fatigue. The recording and analysis of transmission duty cycles as applied to gears are discussed, including reliability calculation for constant stress and speed, cumulative damage, damage capacity and damage rate, effective stress, reliability calculation for a variable duty cycle, and use of a digital computer in evaluating gear reliability. Finally, trade-off methods for improving the reliability of a transmission assembly are discussed. L.E.W.

N67-16183# Army Material Research Agency, Watertown, Mass.
DEVELOPMENT OF PRACTICE FOR COMPOSITE ROLLING OF STRUCTURAL METAL PANELS Quarterly Report, May 15–Aug. 15, 1966
K. R. Grube, J. R. VanOrsdel, and E. S. Bartlett Aug. 1966 58 p refs
(Contract DA-19-066-AMC-308(X))
(AMRA-CR-66-02/3; QR-3; AD-641408) CFSTI: HC $3.00/MF $0.65

Structural panels prepared of Inconel and the alpha-titanium alloy Ti-4A1-0.202 were successfully bonded by the roll-welding process. The use of a reactive metal in the assembled pack to getter gaseous impurities appears to aid the bonding of the faying surfaces of the PH 14-8Mo alloy. Satisfactory titanium-beryllium composite strip were produced using silver as a diffusion barrier. Author (TAB)

N67-16211# New York Univ., N. Y. Lab. for Electroscience Research.
ON THE OPTIMUM TWO-DIMENSIONAL ALLOCATION PROBLEM
Murray J. Haims Jun. 1966 150 p refs
(Grants AF-AFOSR-24-65; AF-AFOSR-24-66)
(AFOSR-66-2698; TR-400-136; AD-642761) CFSTI: HC $3.00/MF $0.65

The general two-dimensional allocation problem is the problem of deciding how to cut two-dimensional shapes from given sheets of stock material in an optimum manner without having to make an exhaustive search through all possible arrangements. Two categories of problems are studied. The first, known as template-layout problems, require that one cut as many pieces as possible from a single sheet of material. The second, known as cutting-stock problems, require that pieces be cut from as many sheets as necessary in order that the number of pieces meet a fixed demand. The solution for the template-layout problem is divided into two phases. First, the irregular-shaped pieces are fitted together in clusters and enclosed by modules. Second, the resulting modules are packed into the rectangular sheets so that the arrangements optimize an objective function. The packing methods make it feasible to pack rectangular, L-shaped, and right-triangular modules in rectangular sheets. A test program has been written that can pack ten different rectangular modules into a family of sheets ranging from 1 square unit to 250 square units. The cutting stock problem is formulated as a linear programming problem. It is shown that the solution may be obtained by using the revised simplex method in conjunction with the algorithm for solving the template-layout problem, at every pivot step, to generate new columns for the linear programming problem. Author (TAB)

N67-16389# California Univ., Livermore. Lawrence Radiation Lab.
THERMAL STRESSES IN INFINITE FLAT PLATES
Bradley M. Johnston 30 Jun. 1966 52 p refs
(Contract W-7405-ENG-48)
(UCRL-14737) CFSTI: HC $3.00/MF $0.65

A simple experimental procedure was developed for determining the expansion of the cutting tool during a turning operation. The experiment revealed the magnitudes of possible size and form errors due to tool expansion, the variation of effects with speed, feed, and depth of cut, and the effectiveness of coolant as a means of reducing the error. Author (NSA)

N67-16423# Picatinny Arsenal, Dover, N. J. Plastics and Packaging Lab.
USE OF LOW-MELTING METAL ALLOYS FOR CASTING AND TRANSFER MOLDING OF HOLLOW PLASTIC SPHERES
S. A. Slota Nov. 1966 12 p
(PA-TR-3320; AD-641974) CFSTI: HC $3.00/MF $0.65

In order to produce a hollow plastic ball with only a small opening at one point, a core insert, made from a low melting alloy, was used in both a casting mold and a transfer mold. In the casting process, the plastic was poured into the mold as a liquid and cured at room temperature. In the transfer process, the plastic was forced into the mold cavity under pressure (3000 psi) and cured at 310F. In both cases, the finished ball (with insert inside) was heated in a mineral oil bath at 350F to melt the core. This melted core material was poured out of the plastic ball through the small opening and was reused for casting additional cores.
Author (TAB)

N67-16456# Naval Air Engineering Center, Philadelphia, Pa.
EVALUATION OF ENVIRONMENTAL PROTECTION AFFORDED TO SYSTEM STOCKS OF ANTI-FRICTION BEARINGS
E. J. Lion 17 Nov. 1966 35 p
(NAEC-AML-2447; AD-643354) CFSTI: HC $3.00/MF $0.65

Laboratory examinations were conducted to evaluate the condition of stock bearings received from various field installations. The preservation, packaging and packing of each bearing was evaluated with each component of the pack being examined for signs of deterioration.
Author (TAB)

N67-16509*# Ampex Corp., Redwood City, Calif.
STUDY, FABRICATION, AND TESTING OF A FOIL BEARING ROTOR SUPPORT SYSTEM Quarterly Report, Period Ending 15 Nov. 1966
15 Nov. 1966 19 p
(Contract NASw-1456)
(NASA-CR-81266; RR-66-38) CFSTI: HC $3.00/MF $0.65 CSCL 13H

After demonstrating the feasibility of supporting a high-speed rotor on foil bearings, runs of moderate duration were conducted on the existing test rig. Design of the apparatus focused on test methods of starting and investigations of the response of the foil rotor system to external excitation. Construction of an orbit program through a single-foil model and a three-foil rotor support is mentioned.
S.P.

N67-16541*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A STUDY OF THE EFFECTS OF VARIOUS HEAT INPUT RATES ON T-1A STEEL WELDS
S. W. Worden (Chrysler Corp.), M. G. Olsen, and R. A. Davis 14 Nov. 1966 39 p refs
(NASA-TM-X-53537) CFSTI: HC $3.00/MF $0.65 CSCL 13H

An experimental program was executed to evaluate the effects of welding-restrained butt-joints of T-1 and T-1A steel plate under conditions involving variations of weld heat input rates, plate thickness, and weld groove design. Tensile tests, hardness measurements, and bend tests were made for each set of conditions. Test results show that close control is necessary to prevent overheating these steels during welding. Considerable strength and toughness losses are incurred through overheating. Production controls and preproduction development necessary to assure weldment integrity are discussed.
Author

N67-16599# Martin Co., Denver, Colo.
CENTER FOR HIGH ENERGY FORMING Fifth Quarterly Report, Jul. 1–Oct. 1, 1966
G. A. Thurston 1 Oct. 1966 110 p refs Prepared Jointly with Denver Univ.
(Contract DA-19-066-AMC-266(X))
(AMRA-CR-66-0516; AD-641407) CFSTI: HC $3.00/MF $0.65

The first section describes the studies performed on shock hardening and strain rate effects. The second section discusses efforts in predicting strains in blanks formed into dies and in experimental work in material ductility in explosive forming and in blank stabilization. The third section contains a complete report of a literature survey of shock hardening effects on 18 per cent nickel maraging steel.
Author (TAB)

N67-16614*# Army Biological Labs., Fort Detrick, Md. Physical Defense Div.
EFFECTIVENESS OF DRY HEAT AND ETHYLENE GAS UPON SPORE CONTAMINATION LOCATED BETWEEN MATED SURFACES AND ON EXTERIOR SURFACES OF VARIOUS MATERIALS
Dorothy M. Portner 7 Dec. 1966 7 p refs
(NASA Order R-35)
(NASA-CR-81344) CFSTI: HC $3.00/MF $0.65 CSCL 13H

As part of an overall investigation of spacecraft sterilization, a comparative study was conducted to determine whether there is an appreciable difference in the sterilizing effectiveness of dry heat or ethylene oxide gas on microbial contamination located between mated surfaces, in contrast to the contamination located on the external surface of a material. Tests were conducted and the results show that dry heat is as effective against spore contamination located between mated surfaces as against contamination on the exterior surface of the various materials. Ethylene oxide gas was also equally effective against spore contamination located between mated surfaces or on the exterior surface of steel or glass. There appears to be no evidence that extended exposure period will be necessary to sterilize mated surfaces. However, if the surfaces are hermetically sealed, sterilization can not be attained with ethylene oxide gas and longer exposure periods with dry heat are needed to kill microorganisms entrapped in solids.
C.T.C.

N67-16647# California Univ., Berkeley. Dept. of Mechanical Engineering.
ANALYTICAL PREDICTION OF DEFECTS FOR EXTRUSION THROUGH CONICAL DIES OF VARYING REDUCTIONS AND DIE ANGLES Progress Report
Taylan Altan and Sairo Kobayashi Jul. 1966 236 p refs
(Contract AF 33(615)-3283)
(AD-641257) CFSTI: HC $3.00/MF $0.65

The principal aim during the first year of investigation was to develop a theoretical method of analysis for obtaining the detailed mechanics of the extrusion process, with special reference to extrusion through conical dies. The visioplasticity and upper-bound methods were summarized, and the method of calculating temperature distributions was reviewed. Extended treatment of admissible velocity fields was then made, and a numerical method was developed for predicting the non-steady-state temperature distributions. A computer program of the entire procedure was completed for general use.
Author (TAB)

N67-16695*# Stanford Research Inst., Menlo Park, Calif.
POLYMERS FOR SPACECRAFT HARDWARE: MATERIALS CHARACTERIZATION, PART I Interim Report, Mar.–Dec. 1966
E. Cleland, R. Harrington, and H. Maxwell 9 Dec. 1966 144 p ref Prepared for JPL
(Contracts NAS7-100; JPL-950745)
(NASA-CR-81377; IR-3, Pt. I) CFSTI: HC $3.00/MF $0.65 CSCL 13H

In selecting polymeric materials to be used for spacecraft, the effect of a simulated environment on selected commercial products is examined. More than 200 polymeric products were screened by a special micro-method that gives values for total weight loss and for the maximum amount of the volatile condensable substances which condense on an adjacent cooler surface, i.e., volatile condensable materials. Identification of the substances released by polymers in a thermal-vacuum environment was made possible by mass spectrometry. Measurements of selected mechanical properties of elastomers and plastics during 6-week storage periods in the thermal-vacuum environment, are discussed

and compared with the performance of selected materials stored for as long as 9 months in the thermal-vacuum environment. A comprehensive polymer test program is described which provides for physical mechanical property testing of as many as 30 polymeric materials exposed simultaneously to a decontamination and thermal-vacuum environments. Results for 22 products are reported for properties such as hardness, dimensional change, tensile, and dielectric constant. S.P.

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N67-15343# Army Electronics Labs., Fort Monmouth, N. J.
INJECTION LASER DRIVING CIRCUIT FOR HIGH-CURRENT, HIGH-REPETITION-RATE OPERATION
Rudolph R. Gammarino, Ernst J. Schiel, and Gerald A. Talbot Aug. 1966 21 p refs
(ECOM-2753; AD-640481) CFSTI: HC $3.00/MF $0.65

The report describes a high current solid-state pulser that has been developed to drive injection lasers from room-temperature operation. Two basic charging circuits are detailed, and the advantages and disadvantages of each are analyzed. The discharge circuit is described, and the factors in the discharge circuit which determine the peak current and pulse width are investigated. The performance of the various solid-state switching devices, silicon-controlled rectifiers (SCR's), employed in the circuit is also discussed. Author (TAB)

N67-15353# Westinghouse Electric Corp., Baltimore, Md.
THERMAL OPTIC DISTORTION Final Report, 16 Jun. 1965–1 Oct. 1966
E. P. Riedel and G. D. Baldwin 31 Oct. 1966 113 p refs
(Contract Nonr-4874(00); ARPA Order 306; Proj. Defender)
(MDE-1198; AD-642540) CFSTI: HC $3.00/MF $0.65

The optical distortion in neodynium doped glass which is induced by pump radiation is described. Optical distortion was observed at 6328A and the optical path length was found to be dependent on four primary effects: (1) change in physical length; (2) change in refractive index due to temperature rise; (3) change in index resulting from stress; (4) change in index associated with an excited state population of neodymium ions. The experimental techniques used and the results obtained are presented. Included are measurements of optical path length variations, pump-induced birefringence, change in physical length, change in refractive index, bulk temperature rise, and the deflection of a light beam. The theory of thermal optic distortion was developed for the first time to include Fermat's principle. This approach leads to equations defining both the slope and trajectory of rays through the material. The resulting equations are employed to predict ray refraction, beam divergence, and the optical path length through the material as a function of radius, time, and polarization. Good agreement between theory and experiment is achieved provided a new term is added to the expression for the change in refractive index. This term arises from the fact that the polarizability of the neodymium ion in its excited 4F(3/2) level is different from its value in the 41(9/2) ground level. The inclusion of this new term in the expression for the change in refractive index implies that large optical distortions can exist in 'athermalized' glass. Author (TAB)

N67-15769# Library of Congress, Washington, D. C. Aerospace Technology Div.
AN INFRARED BEAM LASER [PUCHKOVYY KVANTOVYY GENERATOR INFRAKRASNOGO DIAPAZONA] Translations of Foreign Scientific and Technical Literature
N. G. Basov, A. I. Orayevskiy, and V. A. Shcheglov 12 Aug. 1966 7 p refs Transl. into ENGLISH from Zh. Eksperim. Teor. Fiz. (Moscow), v. 4, no. 2, 1966 p 61–62
(ATD-66-102)

The possibility of producing a thermally excited infrared beam laser is discussed. The thermal pumping is based on the possibility of selecting those energy levels of a molecule E_β molecular beam would be emitted into a vacuum where the temperature of radiation equilibrium is considerably lower $(E_\beta - E_\alpha)/k$. Due to spontaneous emission, level α is rapidly depleted, and a population inversion can occur for the transition $\beta \rightarrow \alpha$. The necessary condition for obtaining population inversion between levels β and α standpoint of the proposed method is 3–20 μ. For shorter wavelengths the excited state lifetimes are too short, and for longwave transition, the excited state lifetimes become too long (making instrument dimensions excessively large). An energy level diagram of vibrational levels of the CO_2 molecule suitable for obtaining population inversion in the molecular beam, is given. Similar transitions in the N_2O and HCN molecules are described. L.S.

N67-16014* Maryland Univ., College Park. Dept. of Physics and Astronomy.
STUDY OF THE PHYSICS OF LASER RADIATION Progress Report, 15 Oct. 1964–15 Oct. 1966
C. O. Alley 15 Oct. 1966 97 p refs
(Grant NGR-21-002-022)
(NASA-CR-81248) CFSTI: HC $3.00/MF $0.65 CSCL 20E

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11. OPTICAL RADAR DETECTION OF BACKSCATTERING FROM THE UPPER ATMOSPHERE (75-160 km) P. D. McCormick, S. K. Poultney, U. Van Wijk, C. O. Alley, R. T. Bettinger et al 3 p refs (See N67-16016 06-16)
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13. ONSET OF LONG-RANGE ORDER IN A CRITICAL SOLUTION OF MACROMOLECULES J. A. White, J. S. Osmundson, and B. H. Ahn 4 p refs (See N67-16018 06-23)
14. DYNAMICAL COMPUTATION OF PHOTON CORRELATIONS AND COUNTING STATISTICS V. Korenman 31 p refs (See N67-16019 06-23)
15. POLARIZATION AND ABSORPTION EFFECTS ON THE FRAUNHOFER DIFFRACTION PATTERNS OF A CORNER REFLECTOR C. O. Alley, R. F. Chang, D. G. Currie, and M. E. Pittman 26 p refs (See N67-16020 06-23)

N67-16015* Maryland Univ., College Park. Dept. of Physics.
OPTICAL RADAR USING A CORNER REFLECTOR ON THE MOON

P. L. Bender, J. E. Faller (Joint Inst. for Lab. Astrophys.), R. H. Dicke (Princeton Univ.), P. A. Franken (Mich. Univ.), C. O. Alley et al *In its* Study of the Phys. of Laser Radiation 15 Oct. 1966 3 p refs Repr. from J. Geophys. Res., v. 70, no. 9, 1 May 1965 p 2267–2269 (See N67-16014 06-16) CFSTI: HC $3.00/MF $0.65

In the optical radar system considered, the pulsed or continuous wave laser beam is sent through a transmitting telescope which tracks the corner reflector on the moon's surface. A small part of the reflected light is collected by the receiving telescope, which also tracks the reflector. The correlator measures the light travel time to the reflector and back. A formula is given for approximating the efficiency of such a system, that is the ratio of the number of received to the number of transmitted photons. This indicates the need for a high power laser as the light source, since the expected return from the corner reflector is some 100 times stronger than that due to diffuse scattering by the lunar surface. It is also pointed out that the corner reflector and its mounting must be designed carefully in order to avoid environmental problems on the moon's surface. The passivity and the expected reliability of the corner reflector, and the high accuracy of the optical ranging are cited as the chief advantages of the system. M.G.J.

N67-16016* Maryland Univ., College Park. Dept. of Physics and Astronomy.

OPTICAL RADAR DETECTION OF BACKSCATTERING FROM THE UPPER ATMOSPHERE (75–160 km)

P. D. McCormick, S. K. Poultney, U. Van Wijk, C. O. Alley, R. T. Bettinger et al *In its* Study of the Phys. of Laser Radiation 15 Oct. 1966 3 p refs Repr. from Nature, v. 209, no. 5025, 19 Feb. 1966 p 798–799 (See N67-16014 06-16) CFSTI: HC $3.00/MF $0.65

(Contracts ARPA SD-101; NObsr-72710; Grant WBG-4-FY-64)

Summary data are presented on the studies, which used an optical radar consisting of a ruby laser capable of producing single pulse containing 6 to 10 J at 6943 Å with a width of 10 nsec and a beam divergence of no more than 10 milliradians. Some preliminary findings are also given. A figure is included to depict the result of a series of shots taken during a short time interval. The scattering appears to be enhanced over the altitude ranges from 100 to 125 km. The total number of counts received (in 10 pulses) from 75 to 150 km was 2240; the background was 350 counts. Thus, the number of photoelectrons due to backscattering is 1890 with a mean error of 51 due to statistical uncertainty. The average of 100 laser pulses, over a period of four hours on a different night, is also depicted. It is seen that the magnitude of the return signal is much lower and no peaks are present. M.G.J.

N67-16017* Maryland Univ., College Park.

COLD CATHODES FOR POSSIBLE USE IN 6328 Å SINGLE MODE He–Ne GAS LASERS

U. Hochuli and P. Haldemann *In its* Study of the Phys. of Laser Radiation 15 Oct. 1966 3 p refs Repr. from Rev. Sci. Instr., v. 36, no. 10, Oct. 1965 p 1493–1494 (See N67-16014 06-16) CFSTI: HC $3.00/MF $0.65

Properly dimensioned aluminum cold cathodes promise single mode 6328 Å He–Ne gas laser lifetimes exceeding 3000 h with total gas volumes of only 50 cm^3. These cathodes are simple, rugged, and require only about 0.5 W for an emission current of 5 mA dc. Beryllium cold cathodes may be even better but more time is needed for their evaluation. Author

N67-16144# Harry Diamond Labs., Washington, D. C.

GALLIUM ARSENIDE LASER RADAR—PRELIMINARY STUDIES

William L. Soper Aug. 1966 24 p refs

(TM-66-13; AD-640540) CFSTI: HC $3.00/MF $0.65

The report discusses preliminary work on room-temperature gallium arsenide laser radar and rangefinding. Experimental results are given for three different laboratory models using receivers of up to 20-in. diameter aperture under daylight conditions. Author (TAB)

N67-16363# Eastman Kodak Co., Rochester, N. Y.

HIGH ENERGY LASER GLASS MATERIAL TECHNIQUES Final Report

Sep. 1966 70 p

(Contract DA-01-021-AMC-12642(Z))

(AD-640097) CFSTI: HC $3.00/MF $0.65

A total of twenty-two new neodymium doped laser glasses were made and compared to the standard Kodak ND-11 silicate based glass. One of these compositions shows promise of having a significantly improved durability under laser action at high energy densities. Several others in certain sizes show improved efficiency. An unwinding technique has also been developed for the fabrication of large laser rods from precast blocks of equal volume, but of much smaller size. Laser rods up to 72 inches were delivered for evaulation to the U. S. Army Missile Command, Redstone Arsenal, Alabama. Author (TAB)

N67-16633*# Ohio State Univ. Research Foundation, Columbus. Dept. of Electrical Engineering.

A PARAMETER STUDY OF A CARBON DIOXIDE GAS LASER

D. B. Rensch 15 Nov. 1966 57 p refs

(Grant NsG-74-60)

(NASA-CR-81332; Rept.-1093.34) CFSTI: HC $3.00/MF $0.65 CSCL 20E

The problem of defining such parameters as discharge tube width and length, gas flow rate, tube wall temperature, and gas mixtures of a CO_2 gas laser is considered. The pertinent theory on symmetry properties of CO_2 and its use as an amplifying medium for infrared frequencies is presented, along with the techniques for determining the effect the above-mentioned parameters have on laser action. The experimental results showed that the parameters can be defined; therefore some of the guess-work in determining optimum laser action for a CO_2 gas laser can be removed. Also, laser operating frequency, symmetry properties, and amplifying characteristics of CO_2 can be correlated with theory. Author

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N67-15401# Beryllium Corp., Reading, Pa.

DEVELOPMENT OF SOLID SOLUTION STRENGTHENED HIGH PURITY BERYLLIUM ALLOY SHEET Bimonthly Progress Report, Jun.–Jul. 1966

G. E. Meyer Aug. 1966 7 p

(Contract NOw-66-0563-c)

(AD-639838) CFSTI: HC $3.00/MF $0.65

Three beryllium plus copper alloy ingots were produced. The charges were melted under a vacuum of approximately 150 microns in a BeO coated graphite crucible. At 2460 F the alloy was bottom poured into a 3-1/4 in. diameter graphite mold having a water cooled chill plug attached at the bottom. Preparatory to melting, beryllium electrolytic flacke was cold compacted into cylindrical preforms to minimize melt loss. The copper was added in sections cut from electrolytic copper cathodes. The billets were encased in mild steel jackets and extruded. The extrusion was performed at 1850 F using a 1/4 in. x 1-1/2 in. die which produced a 14.3:1 reduction ratio. Conclusions are: (1) Copper additions to

high purity beryllium yield an alloy with good casting characteristics. (2) Only the increased extrusion forces required to extrude the alloy billets differentiated the alloy extrusions from conventional beryllium ingot extrusions. (3) The degree of surface roughness of the extruded alloy slabs was greater than the roughness of pure beryllium slabs, and this roughness could be related to the grain size variation in the casting. Author (TAB)

N67-15501 Argentina. Comision Nacional de Energia Atomica, Buenos Aires.

FIRST LATIN AMERICAN CONFERENCE ON PROCESS METALLURGY AND METAL WORKING, VOLUME II [PRIMERA CONFERENCIA DE EXPERTOS LATINOAMERICANOS EN METALURGIA DE TRANSFORMACION, VOLUMEN II]

Aug. 1966 399 p refs *In* SPANISH, ENGLISH, and PORTUGUESE Conf. held in Buenos Aires, 18–23 Aug. 1964
(Grant AF-AFOSR-717-65)
(AFOSR-66-2001, Vol. II; AD-640371) CFSTI: HC $3.00/MF $0.65

Conference papers on problems, techniques, manufacturing processes, materials research, and national programs in metal working are presented. For individual titles see N67-15502–N67-15521.

N67-15502 Instituto de Pesquisas Technologicas, Sao Paulo (Brazil).

SOME PROBLEMS RELATED TO THE CORROSION OF METALS [ALGUNS PROBLEMAS DE CORROSAO DE METAIS]

Stephan Wolynec and Idel Metzger *In* Arg. Comision Nacl. de Energia Atomica 1st Latin Am. Conf. on Process Met. and Metal Working, Vol. II Aug. 1966 52 p refs In PORTUGUESE; ENGLISH summary Presented at the Brazilian Metal Assoc. 19th Ann. Congr., Sao Paulo, Jul. 1964 (See N67-15501 06-17) CFSTI: HC $3.00/MF $0.65

For increased industrial safety and equipment efficiency, a theoretical analysis of corrosion mechanisms is presented. Various types and causes of corrosion are identified, and chemical analysis or metallographic test procedures described. The following mechanisms are involved: stray current corrosion of underground piping, stress corrosion of concrete reinforcements, crevice corrosion of stainless steel sheets, and intergranular corrosion due to carbide precipitation in stainless steel tubing. An extensive bibliography is included. Transl. by R.Ll.

N67-15512 Argentina. Comision Nacional de Energia Atomica, Buenos Aires.

FABRICATION AND PROPERTIES OF A HIGH RESISTANCE TO SOFTENING AND HIGH CONDUCTIVITY COPPER ALLOY [PROPIEDADES DE UNA ALEACION DE COBRE DE ALTA RESISTENCIA AL ABLANDAMIENTO Y ALTA CONDUCTIVIDAD]

D. Obrutsky, M. Sarrate, and O. Wortmann *In its* 1st Latin Am. Conf. on Process Met. and Metal Working, Vol. II Aug. 1966 14 p refs In SPANISH; ENGLISH summary (See N67-15501 06-17) CFSTI: HC $3.00/MF $0.65

The superior properties of Cu–Zr alloys over Cu–Cr and Cu–Ag alloys are assayed for possible industrial application to conductors, transformers, and electronic equipment fabrication. Specimens of different compositions were prepared and their aging characteristics determined by dilatometry, hardness, conductivity, thermoelectric power, and shear-strength measurements made on deformed and aged specimens. An increase of hardness was observed for 500°C, 5 min aging, accounted for by a single mechanism. Activation energy for the aging process was established at about 23,000 cal/mol. It is considered that electrodes made under the optimum combination of properties showed excellent performance in industrial applications. Transl. by R.Ll.

N67-15519 Instituto Nacional de Technologia Industrial, Buenos Aires (Argentina).

THE EFFECT OF SIZE AND SHAPE ON THE FATIGUE STRENGTH OF STRUCTURAL AND MACHINE MEMBERS [INFLUENCIA DEL EFECTO DE TAMANO Y ENTALLADURA EN LA RESISTENCIA A LA FATIGA DE ELEMENTOS ESTRUCTURALES Y DE MAQUINAS]

Roberto Kuguel *In* Arg. Comision Nacl. de Energia Atomica 1st Latin Am. Conf. on Process Met. and Metal Working, Vol. II Aug. 1966 17 p refs In SPANISH; ENGLISH summary (See N67-15501 06-17) CFSTI: HC $3.00/MF $0.65

Steel and aluminum alloys specimens were tested to determine the effect of size and shape on the fatigue resistance of machines and their structural components. Mathematical expressions derived indicate that fatigue resistance in metals decreases as the surface tension volume increases. A straight line relationship was found between the logarithm of that volume and the logarithm of the maximum stress; the slope appears to be the same for all materials tested within the ±10% dispersion band. An experimental relationship was verified between the theoretical and real stress concentration factors. Transl. by R.Ll.

N67-15683*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

EVALUATION OF OXIDATION-RESISTANT COATINGS FOR INERT-ATMOSPHERE APPLICATIONS

W. M. Phillips 15 Jan. 1967 24 p refs
(Contract NAS7-100)
(NASA-CR-81191; JPL-TR-32-1014) CFSTI: HC $3.00/MF $0.65
CSCL 11F

A series of oxidation-resistant coatings were tested in argon containing traces of oxygen and water vapor at 2000°F for 500 hr. Coatings tested were tin–aluminum and modified silicides applied to a substrate of Cb–1 Zr and an unmodified silicide applied to a subcoating of molybdenum on Cb–1 Zr. Evaluation of the samples was done by metallography, microhardness testing, bend testing, and microprobe analysis. The chromium-modified silicides offered little oxidation protection under these conditions and resulted in chromium diffusion into the substrate. The tin–aluminum coating produced adequate oxidation resistance despite spalling. The use of the unmodified silicide over a diffusion barrier of molybdenum appeared to be the most effective technique of protection. Author

N67-15770# Library of Congress, Washington, D. C. Aerospace Technology Div.

THE WIDTH OF THE HOMOGENEITY REGION OF INTERMETALLIC PHASES IN THE Nb–Sn and V–Ga SYSTEMS Translations of Foreign Scientific and Technical Literature

V. S. Kogan, B. G. Lazarev, A. A. Matsakova, O. N. Ovcharenko, and L. Ya. Yakimenko 9 Aug. 1966 11 p refs Transl. into ENGLISH from Fiz. Metal. i Metalloved. (USSR), v. 21, no. 6, 1966 p 828–832
(ATD-66-101)

To verify the assumptions that the presence of the homogeneity regions of Nb_3Sn and V_3Ga compounds noted in the majority of published phase diagrams is caused by the nonequilibrium in the specimens, an investigation was made on these compounds obtained by the reaction diffusion method. It is shown that the compounds have a much more narrow homogeneity region than the specimens obtained by metallurgical methods. Author

N67-15802*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

A THEORY OF PARTICLE–PARTICLE INTERACTION DESCRIBING THE MECHANICAL PROPERTIES OF DENTAL AMALGAM

B. G. Moser and R. F. Landel *In its* Space Programs Sum. No. 37–40, Vol. 4 31 Aug. 1966 p 84–92 refs (See N67-15781 06-34) CFSTI: HC $3.00/MF $0.65

Data are reviewed on the theory of the limiting volumetric loading which describes how particles will pack randomly into beds. An application to dental amalgams is shown, in which the malagam mix is considered as a slurry of solid particles whose interstices are filled with a liquid. In this case the solid is the silver alloy, and the liquid is the mercury. The particle size distribution of experimental dental alloy is tabulated, and details are given on specimen preperation and experimental methods. Preliminary results indicate: (1) The mechanical properties of dental amalgam are governed by the same parameters which govern the rheological behavior of other filled systems. (2) Particle size, size distribution, surface area, and surface energy of the alloy affect the amalgam's properties but are all reflected by a single parameter, ϕ_m (sedimentation volume). (3) The properties vary with residual mercury, which is $(1-\phi)$, where ϕ is the volumetric concentration of alloy particles. However, all properties can be normalized to a single master curve by considering a reduced concentration scale ϕ/ϕ_m. M.G.J.

N67-15833*# Battelle Memorial Inst., Columbus, Ohio.
INVESTIGATION OF MECHANICAL PROPERTIES OF CHROMIUM, CHROMIUM-RHENIUM, AND DERIVED ALLOYS Final Report, Apr. 1–Aug. 31, 1966
A. Gilbert, M. J. Klein, and J. W. Edington 31 Aug. 1966 84 p refs
(Contract NASw-101)
(NASA-CR-81225) CFSTI: HC $3.00/MF $0.65 CSCL 11F

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3. THE EFFECT OF TEMPERATURE ON THE HARDNESS OF Cr–Re ALLOYS IN THE RANGE 0–40 AT.% Re A. Gilbert 12 p (See N67-15836 06-17)

4. ACTIVATION VOLUME ANALYSIS FOR Cr AND Cr-35 Re A. Gilbert 8 p (See N67-15837 06-17)

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6. THE RHENIUM ALLOYING EFFECT A. Gilbert 14 p (See N67-15839 06-17)

7. QUENCHED-IN DEFECTS IN Mo–35Re A. Gilbert and J. W. Edington 7 p refs (See N67-15840 06-17)

N67-15834*# Battelle Memorial Inst., Columbus, Ohio.
THE EFFECT OF QUENCHING ON THE DUCTILE–BRITTLE BEND-TRANSITION TEMPERATURE OF CHROMIUM WIRE
A. Gilbert and M. J. Klein *In its* Invest. of Mech. Properties of Chromium, Chromium–Rhenium, and Derived Alloys 31 Aug. 1966 5 p (See N67-15833 06-17) CFSTI: HC $3.00/MF $0.65

In order to make a meaningful comparison of the mechanical properties of quenched and slow cooled material, some sensitive measure is needed of the amount of interstitial retained in solution compared to that present as second phase. Experiments were conducted to make such a comparison on Cr that had been quenched at a very high rate, using internal friction as an indicator of the amount of nitrogen in solution. Nitrogen has been considered to be the interstitial primarily responsible for the brittleness of Cr. The investigation, together with a nitrogen analysis, shows that all the nitrogen present in the material is in solid solution as a result of the quench, and that after aging for times greater than 3000 minutes it is largely present as a precipitated phase in accordance with the predictions of equilibrium solubility data. Thus, it appears that nitrogen completely in solution is less detrimental to ductility than when present as a second phase. C.T.C.

N67-15835*# Battelle Memorial Inst., Columbus, Ohio.
THE EFFECT OF QUENCHING ON THE DUCTILE–BRITTLE BEND–TRANSITION TEMPERATURE OF Cr–35Re WIRE
A. Gilbert and M. J. Klein *In its* Invest. of Mech. Properties of Chromium, Chromium–Rhenium, and Derived Alloys 31 Aug. 1966 16 p (See N67-15833 06-17) CFSTI: HC $3.00/MF $0.65

An investigation was made of the effect of impurities on the ductility of a high-Re alloy. Also investigated were the mechanisms of any potential impurity-embrittling effect, and whether impurity in solution is a more potent embrittling agent than when present as a second phase, or vice versa. Experiments were conducted on wires of Cr–35Re containing two different levels of nitrogen. The bend properties were determined for material of the two nitrogen levels in the quenched condition and also after two different aging treatments. Internal friction techniques were used to monitor the amount of nitrogen actually in solution. The major conclusion is that the change in the bend-transition temperature of the wire produced by changes in impurity level and heat treatment appears to reflect primarily the effect of these variables on the deformation response of the matrix. C.T.C.

N67-15836*# Battelle Memorial Inst., Columbus, Ohio.
THE EFFECT OF TEMPERATURE ON THE HARDNESS OF Cr–Re ALLOYS IN THE RANGE 0–40 AT.% Re
A. Gilbert *In its* Invest. of Mech. Properties of Chromium, Chromium–Rhenium, and Derived Alloys 31 Aug. 1966 12 p (See N67-15833 06-17) CFSTI: HC $3.00/MF $0.65

Since the superconducting properties are a reflection of the electronic structure of an alloy as are ultimately the plastic properties, an investigation was made of the change in mechanical properties of Cr–Re alloys at approximately the same composition as that at which Cr–Re alloys become superconducting. Tests were run on a series of Cr–Re alloys to see at what composition the behavior changes from that characteristic of Cr to that characteristic of Cr–35 at.% Re. Tests were also made at temperatures below ambient to assess the effect of Re on the temperature dependence of strength in chromium. In order to determine the effect of Re on the Peierls stress of Cr, hardness determinations were made at liquid hydrogen temperature. It was found that a marked solid solution softening at low temperatures produced in Cr by Re additions of >20 at.% may be a critical factor in the concurrent enhancement of ductility. It is suggested that the mechanism underlying this softening is a lowering of Peierls barrier by addition of Re. It may also be that the presence or absence of such an effect represents a critical test for the operation of a "Re-type" enhancement of ductility. C.T.C.

N67-15837*# Battelle Memorial Inst., Columbus, Ohio.
ACTIVATION VOLUME ANALYSIS FOR Cr AND Cr-35 Re
A. Gilbert *In its* Invest. of Mech. Properties of Chromium, Chromium–Rhenium, and Derived Alloys 31 Aug. 1966 8 p (See N67-15833 06-17) CFSTI: HC $3.00/MF $0.65

In bcc materials the strong temperature dependence of the flow stress is thought to be a result of a thermally activated "climbing" by dislocations of the Peierls Nabarro energy barrier. The change in the temperature dependence of the flow stress produced by Re alloying could thus be a reflection of a change in the mechanism controlling flow. In order to investigate this possibility a series of strain-rate cycling experiments was carried out at different temperatures to evaluate the stress dependence on the activation volume of the process controlling deformation in Cr and Cr–35Re. Conclusions are that this metal exhibits typical bcc behavior in terms of the effect of grain size on flow stress and ductility. The fine grained material is both stronger and more ductile than the coarse, whereas in unalloyed Cr it is less ductile than is the coarse-grained material. In addition, the Cr–35Re samples exhibited a Luders plateau in the stress strain curve that is also characteristic of fine grained bcc material. From an activation volume

analysis it is apparent that the process controlling flow in both Cr and Cr–35Re is a thermally activated climbing of the Peierls barrier. C.T.C.

N67-15838*# Battelle Memorial Inst., Columbus, Ohio.
EFFECT OF RHENIUM ON THE STRAIN-RATE SENSITIVITY OF CHROMIUM AT ROOM TEMPERATURE
A. Gilbert *In its* Invest. of Mech. Properties of Chromium, Chromium–Rhenium, and Derived Alloys 31 Aug. 1966 4 p (See N67-15833 06-17) CFSTI: HC $3.00/MF $0.65

It is reported that an investigation was made of the effect of Re on the room-temperature strain rate sensitivity of Cr over a wide range of values. The experimental methods are briefly described, and the results are justified. It was found that the plastic flow process is thermally activated, with a decrease in the temperature dependence of the flow stress produced by Re additions being reflected in a corresponding decrease in strain rate sensitivity. The results substantiate conclusions obtained by earlier strain rate cycling which indicated that Cr–35Re is much less strain rate sensitive than unalloyed Cr. In addition it is apparent that at the strain rates reach during brittle crack propagation, Cr–34Re can actually deform at lower stresses than can Cr. Such insensitivity to strain rate may be vital with regard to enhancing the ductility of the alloy over that of Cr in that it permits plastic flow to occur rather than cleavage. C.T.C.

N67-15839*# Battelle Memorial Inst., Columbus, Ohio.
THE RHENIUM ALLOYING EFFECT General Discussion
A. Gilbert *In its* Invest. of Mech. Properties of Chromium, Chromium–Rhenium, and Derived Alloys 31 Aug. 1966 14 p refs (See N67-15833 06-17) CFSTI: HC $3.00/MF $0.65

A study was made of the relative importance of the effects produced by additions of Re to W, Mo, and Cr. These effects include plastic deformation, the promotion of twinning at temperatures above ambient, a change in the fracture mode from cleavage to grain boundary failure, a change in the recrystallization behavior, and modifications to the precipitate morphology. Conclusions are that the determination of which criterion is the main one for producing a Re-type of alloying effect is hampered by lack of sufficient experimental data. C.T.C.

N67-15840*# Battelle Memorial Inst., Columbus, Ohio.
QUENCHED-IN DEFECTS IN Mo–35Re
A. Gilbert and J. W. Edington *In its* Invest. of Mech. Properties of Chromium, Chromium–Rhenium, and Derived Alloys 31 Aug. 1966 7 p refs (See N67-15833 06-17) CFSTI: HC $3.00/MF $0.65

Experiments were conducted to investigate the feasibility of using the quenched-in defect technique to study the effect of Re on vacancy clustering in Mo. Evidence of quenched-in vacancies was obtained in the form of helical dislocations and dislocation loops that were probably produced by degeneration on helices. It is noted that the loops and helices are thought to be the first examples of such defects observed in quenched bcc materials, and that the quenching technique was clearly established. C.T.C.

N67-15931# Bureau of Mines, Reno, Nev.
SOLID-STATE ELECTROMIGRATION OF IMPURITIES IN CERIUM METAL
J. D. Marchant, E. S. Shedd, and T. A. Henrie 1967 17 p refs
(BM-RI-6894)

The Bureau of Mines studied solid-state electromigration to determine the value of the technique as a method of purifying cerium metal. Cerium metal in bars 6 inches long and 1/2 inch in diameter was refined at 600°C by solid-state electrolysis to remove iron, copper, and manganese. Iron and manganese were electrotransported to the anode and copper was electrotransported to the cathode. The concentration of iron at the anode of a cerium bar was 800 times greater than the concentration at the cathode. The concentration of copper was 170 times greater at the cathode than at the anode. A radiotracer technique was used to follow the iron migration in the cerium metal. Molybdenum, silicon, and aluminum impurities were not electrotransported. Author

N67-15932# Bureau of Mines, College Park, Md.
REFINING IRON-CONTAMINATED ZINC BY FILTRATION AND CENTRIFUGATION
J. A. Ruppert and P. M. Sullivan 1967 19 p refs
(BM-RI-6889)

The Bureau of Mines investigated methods of refining iron-contaminated zinc to marketable quality and developed a laboratory-scale process in which aluminum, added as a refining agent, reacted with the iron, forming solid Fe_2Al_5 which floated to the surface of the melt. Solids were separated by both filtration and centrifugation, using a unique type of "dipping" centrifuge devised during the work. Typical zinc recovery was 95 percent, and iron content of the metal was lowered from 0.37 to 0.02 percent. Author

N67-15939# Lockheed Missiles and Space Co., Palo Alto, Calif.
STUDY OF THE DYNAMIC YIELD POINT OF METALS AT SHOCK VELOCITIES TO 1000 m/sec
G. D. Polosatkin, L. A. Kudriavtseva, and V. M. Glazkov [1966] 5 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Metal. (Tomsk), no. 5, 1966 p 121–124

The mechanical properties of metals determined at static velocities, change substantially under impulse loadings. At present the following main directions exist for the methodology of experiments at high strain rates: the method of residual strain in which cylindrical samples are fired at a rigid obstacle, the Hopkinson measuring rod is utilized to investigate the propagation of an elastic stress impulse, and the third method, very similar to the second, uses a resistance strain-gauge. The results in these methods are analyzed by starting from elasticity theory. Author

N67-15975# Carnegie Inst. of Tech., Pittsburgh, Pa.
TRANFORMATION KINETICS, MICROPLASTICITY AND AGING OF MARTENSITE IN Fe–31Ni Final Technical Report
Christopher L. Magee (Ph.D. Thesis) and Harold W. Paxton 1 Sep. 1966 309 p refs
(Contract Nonr-760(14))
(AD-614428) CFSTI: HC $3.00/MF $0.65

The effects of testing temperature and volume fraction of martensite on the microplastic response of unaged Fe-31 Ni martensite-austenite aggregates have been determined. These results, supplemented by other experimental studies, show that two unusual mechanisms of plastic deformation give rise to the apparent softness of the quenched structures. The transformation of retained austenite to martensite during the application of stress gives rise in specified conditions to large microplastic strains. The other strain component, which dominates the microdeformation above the temperature range where transformation occurs, is attributed to stress-assisted relaxation of internal stresses. The measured changes in elastic modulus and internal friction (at 80 kHz) during aging of Fe-31 Ni after quenching cannot be explained by the diffusion of point defects to dislocations. It is suggested that this aging effect is instead due to the motion of dislocations which occurs in order to decrease the internal stress. Experimental results pertaining to the kinetics of the austenite to martensite phase transformation show that no distinguishable athermal component of transformation exists in the Fe-31 Ni alloy. A model for martensitic kinetics is developed which treats the propagation of the interface as analogous to plastic deformation. This model and reconsideration of the implications of dislocation motion in the kinetics of embryo formation both lead to the conclusion that martensitic kinetics should be of a fast isothermal character. Author (TAB)

N67-16078# Brown Univ., Providence, R. I. Oak Ridge National Lab., Tenn.

RELATION BETWEEN THE PETCH 'FRICTION' STRESS AND THE THERMAL ACTIVATION RATE EQUATION

R. W. Armstrong Oct. 1966 6 p refs Prepared in Cooperation with Oak Ridge Natl. Lab.

(Contract ARPA E-35)

(AD-640835) CFSTI: HC $3.00/MF $0.65

The discussion is addressed towards establishing a connection between two alternative constitutive equations that have been used in the past to describe the temperature (and strain rate) dependence of the yield stress of iron. TAB

N67-16125# Institute of Modern Languages, Inc., Washington, D. C.

NEW FINDINGS ON ANODIC OXIDATION OF ALUMINUM [NEUERE ERKENNTNISSE UND ERFAHRUNDEN UEBER VERSCHIEDENE VARIATIONEN DER ANODISCHEN OXYDATION DES ALUMINIUMS]

W. Kaden Ft. Belvoir, Va., Army Engr. Res. and Develop. Labs., Jun. 1966 15 p Transl. into ENGLISH from Aluminium (Dusseldorf), v. 39, no. 7, Jul. 1963 p 424–428

(Contract DA-44-009-AMC-1563(T))

(ERDL-T-1853-66; TT-66-62593; AD-641932) CFSTI: HC $3.00/MF $0.65

One of the anodic-oxidation processes discussed is the Veroxal process which produces films characterized by special high hardness and characteristic coloration. The Veroxal process produces films with tints from silver yellow over brown and various bronze tints to black. The colorations are absolutely light proof and are all obtained with the same bath composition. The color differences are obtained by employing different alloys and, to a limited extent, through different film thickness. Shading of color can be obtained by employing different densities and bath temperatures. TAB

N67-16175# General Motors Corp., Indianapolis, Ind. Allison Div.

TRANSPORT OF CARBON AND NITROGEN FROM STAINLESS STEEL CONTAINING FLOWING POTASSIUM

C. L. Walker, R. G. Fox, and S. L. Schrock *In its* Allison Res. and Eng., Vol. 12, Fourth Quarter 1966 1966 p 2–7 refs (See N67-16174 06-15)

Details are given on the development of kinetic analyses to predict quantitative loss or gain of interstitial elements (carbon, oxygen, and nitrogen) from structural materials used to transport liquid metals in nuclear power systems. A mathematical model is derived and compared with experimental results for the average carbon concentration of stainless steel containment tubing. Results indicated that the diffusional and the first-order diffusional models both predict reasonably good values for the average carbon concentration. It was concluded that liquid potassium systems having operational periods greater than 500 hr had rates for carbon and nitrogen transfer through thick-walled containment controlled by diffusional resistances in the solid metal. These transfer rates do not depend on reaction rates at the solid–liquid interface. It was pointed out that the evaluation of materials for use in liquid metal systems should be facilitated by knowledge of the diffusion coefficients for carbon and nitrogen in the candidate materials. L.E.W.

N67-16204# Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics.

MECHANISMS OF ENVIRONMENT INDUCED SUBCRITICAL FLAW GROWTH IN AISI 4340 STEEL Final Report, 1 May 1965–30 Apr. 1966

H. T. Corten and W. A. Van Der Sluys Oct. 1966 4 p

(Contract DA-31-124-ARO(D)-378)

(AROD-5612-2; AD-641607) CFSTI: HC $3.00/MF $0.65

An experiment designed to study the effect of several variables on the subcritical crack growth rate of a high-strength steel in a water environment was conducted. Double cantilever beam specimens of an AISI 4340 steel were employed to study crack extension rates. The environmental variables included temperature, pH of the liquid environment, electric charging and the combined effect of pH and electric charging. Author (TAB)

N67-16206# Universidad Nacional de Cuyo, San Carlos de Bariloche (Argentina). Instituto de Fisica "Dr. J. A. Balseiro."

THE MECHANISM OF WORK-HARDENING IN F.C.C. CRYSTALS Final Report, 17 Sep. 1963–16 Aug. 1966

Gunther Schoeck and Ricardo Medrano Jul. 1966 32 p refs

(Contract DA-ARO-49-092-64-G27)

(AD-641029) CFSTI: HC $3.00/MF $0.65

The report gives the results of a theoretical and experimental investigation on the work-hardening mechanism in face centred cubic metals. In the theoretical part some of the existing theories of work-hardening were critically analysed. TAB

N67-16242# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

THE INFLUENCE OF ORDERING ON CADMIUM DIFFUSION IN THE ALLOY Mg_3Cd [VLIYANIE UPORYADOCHENIYA NA DIFFUZIYU KADMIYA V SPLAVE Mg_3Cd]

W. Chomka *In its* Nukleonika, Vol. VIII 1966 p 170–173 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The integral remainder method, with the use of the radioisotope ^{115}Cd, was employed to measure the diffusion coefficients of cadmium in single crystals of the alloy Mg_3Cd. The temperature dependence of the diffusion coefficients over and under 155°C was found to be $D_1 = 1.2 \times 10^{-6}$ exp $(-12,800/RT)$ and $D_2 = 4 \times 10^{-5}$ exp $(-16,309/RT)$. Author

N67 16384# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

THE EFFECTS OF IRRADIATION, COLD WORK, AND ANNEALING ON THE MARTENSITE CONTENT OF TWO AUSTENITIC STAINLESS STEELS

J. W. Carter Aug. 1966 22 p refs

(Contract AT(45-1)-1830)

(BNWL-238) CFSTI: HC $3.00/MF $0.65

An investigation of the effects of cold work, thermal exposure, chemical composition, and neutron irradiation on the deformation-induced martensitic transformation in AISI 304 and 348 SS is reported. One experiment was conducted to investigate the relationship between the fluctuations in tensile strength and in martensite content of AISI 304 and 348 SS with 300°C water exposure for extended periods of time. In another experiment the relationship between cold work and martensite content and the effect of annealing on this relationship were studied, and in a third experiment, the effect of irradiation on martensite content and on strain energy requirements for martensite formation were investigated. NSA

N67-16409# Marine Engineering Lab., Annapolis, Md.

HOT CORROSION IN MARINE GAS TURBINE

G. J. Danek, Jr. Oct. 1966 23 p refs

(MEL-392/66; AD-640736) CFSTI: HC $3.00/MF $0.65

The phenomenon of hot corrosion in marine gas turbines is stimulated by the presence of sodium sulfate. Two avenues can be followed to minimize deterioration by hot corrosion: (1) control of environmental conditions to prevent the formation of a molten slag and (2) development of materials to resist corrosive attack. Several techniques have been proposed to curtail the formation of a fused slag: limiting the gas turbine operating temperature which, though effective, seriously limits efficiency and fuel economy (present method); eliminating sea salt from the combustion zone by filtering to avoid formation of the aggressive environment; and

other promising techniques for controlling environmental conditions such as blade cooling and fuel additives. The development of materials with built-in hot corrosion resistance would provide the most desirable solution to the problem. Therefore, considerable effort is being expended to devise tailor-made coatings and alloys. Supporting the development efforts are mechanism studies which are aimed at understanding of the interactions between the marine gas turbine environment and hot section materials, and identifying beneficial alloying constituents. Experience so far indicates that none of the specific approaches alone will provide a complete solution to the problem. Author (TAB)

N67-16411# Chicago Univ., Ill. Dept. of Physics.
THE STRUCTURES OF MERCURY
D. Weaire 1966 15 p refs
(Contract Nonr-2121(22))
(AD-642267) CFSTI: HC $3.00/MF $0.65

A previous suggestion that the pseudopotential method should explain the occurrence of unusual structures for Hg is examined quantitatively by study of the variation of energy with tetragonal and rhombohedral distortion of the fcc structure. Pseudopotentials calculated from fundamentals and fitted to the Fermi surface are used. In both cases the magnitude of the tetragonal distortion which minimizes the energy agrees fairly well with that of the low temperature beta-Hg form. The fcc structure is found to be unstable with respect to rhombohedral distortions as expected, but the simple cubic structure is found to have lower energy than the alpha-Hg structure. This discrepancy can be attributed to inadequacies in the pseudopotentials, and can be rectified by a small adjustment of the potential. Author (TAB)

N67-16502*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala.
DETERMINATION OF THE DIFFUSION COEFFICIENTS IN ALLOYS WITH SEVERAL PHASES
V. T. Borisov, V. M. Golikov, and G. N. Dubinin Huntsville, Ala., Redstone Sci. Inform. Center, Oct. 1966 13 p refs Transl. into ENGLISH from Izd. Akad. Nauk SSSR, Metall. i Gornoe Delo (Moscow), no. 4, 1964 p 147–152 Jointly Supported by Army Missile Command
(NASA-TM-X-59320; RSIC-604) CFSTI: HC $3.00/MF $0.65 CSCL 11F

A method is investigated for determining the diffusion coefficient in cases where a multiphase diffusion layer is formed on the surface zone of a metal. The calculation of the diffusion coefficient is made by using the chromium-saturation of iron in a gas phase as an example. Author

N67-16532# Battelle-Northwest, Richland, Wash.
THE EFFECTS OF AGING ON DISSIMILAR METAL WELDED JOINTS WITH MULTIPASS WELDING OF HASTELLOY X AND HASTELLOY W FILLER METAL
D. R. Ireland Jul. 1966 47 p refs
(Contract AT(45-1)-1830)
(BNWL-290, Pt. I) CFSTI: HC $3.00/MF $0.65

The effect of aging for 500, 1000, and 5000 hr at 1000, 1200, 1400, and 1600°F on the mechanical properties of Hastelloy X weld metal, Hastelloy W weld metal, Hastelloy X-280 base metal, and Haynes 25 base metal were evaluated. Results of bend tests, tensile tests, hardness tests, and metallographic examinations of unaged material and materials aged 500 and 1000 hr are presented. Both weld metals age-embrittle with exposure to temperatures of 1000 to 1600°F, but, on the basis of information to date, Hastelloy W appears to be better suited to prolonged exposure to these temperatures than Hastelloy X weld metal. Hastelloy X-280 maintains a ductility of 40% or more when aged and tested at all four aging temperatures, while Haynes 25 maintains a ductility of 18%. NSA

N67-16564*# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.
EFFECT OF 1000 HOUR THERMAL EXPOSURES ON TENSILE PROPERTIES OF REFRACTORY METAL ALLOYS
G. G. Lessmann [1966] 68 p refs
(Contract NAS3-2540)
(NASA CR-72095; WANL-PR-(P-012) CFSTI: HC $3.00/MF $0.65 CSCL 11F

The effect of 100 and 1000 hour aging on the tensile strength of welds and base metal was determined for the columbium and tantalum base alloys following thermal exposure in ultra high vacuum at: 1500°F, 1800°F, 2100°F, and 2400°F. Alloys were tested at 1800°F, 2100°F, 2400°F, and room temperature. Of ten alloys, three displayed excellent stability (FS-85, C-129Y, and SCb-291) and six responded with modest changes in tensile properties (T-111, T-222, Ta-10W, B-66, Cb-752, and D-43Y). The remaining alloy, D-43, averaged in a classic manner losing strength with a time-temperature dependence during thermal exposure. Author

N67-16572*# TRW Systems, Redondo Beach, Calif. Electric Propulsion Technology Dept.
PROGRAM OF ANALYTICAL AND EXPERIMENTAL STUDY OF POROUS METAL IONIZERS, VOLUME I Summary Report, 5 Apr. 1965–5 May 1966
Haywood Shelton and David F. Hall 22 Jan. 1967 132 p refs
(Contract NAS3-7109)
(NASA-CR-54694; TRW-4429-6013-RO-000) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Cesium ion and neutral emission were measured from pure and alloyed porous metal ionizers at current densities up to 50 ma/cm. The neutral emission was measured as a function of the angle from the normal and found not to be distributed as the cosine. Iridium, iridium–tungsten alloy, rhenium–tungsten alloy, and pure tungsten emitters were studied. In addition, the effects of Ta, Nb, Mo, Rh, Pt, C, Si and Al on the surface of porous W emitting cesium ions were studied. Author

N67-16592# Naval Ordnance Lab., White Oak, Md.
PROTECTIVE COATINGS FOR MAGNESIUM
John R. Aldridge 14 Sep. 1966 45 p refs
(NOLTR-66-110; AD-641177) CFSTI: HC $3.00/MF $0.65

Following a survey of military specifications, several coatings were tested for the Signal, Smoke and Illumination, Submarine, Ex 85, Mod 0, which is made of magnesium. The best materials were subjected to salt spray tests. Results show alkaline resistant coatings of 2.0 to 4.0 mils, such as epoxies, polyurethanes and vinyls, are satisfactory over suitable pretreatments. Author (TAB)

N67-16606*# Hydronautics, Inc., Laurel, Md.
CAVITATION DAMAGE IN LIQUID METALS (POTASSIUM STUDIES) Technical Progress Report, 1 Aug.–31 Oct. 1966
H. S. Preiser and S. L. Rudy 28 Nov. 1966 16 p refs
(Contract NAS3-8506)
(NASA-CR-72131; TPR-607-2) CFSTI: HC $3.00/MF $0.65 CSCL 11F

Cavitation damage data are presented showing the rate of volume change as a function of test duration for 316 stainless steel in liquid potassium at 400°F, and for T2C alloy in the stress-relieved condition in 600°F potassium. The effect of potassium temperature from 400°–1200°F on the steady-state zone rate of damage of 316 stainless steel is also given. These tests have been run in pure liquid potassium with measured oxide contamination of 18 PPM or less. The data compared to similar experiments in liquid sodium show that peak rates of damage for 316 stainless steel occur at 800°F for potassium and 400°F for sodium, and that the steady-state volume loss of 316 stainless steel at 400°F in sodium is twice that for 400°F potassium. Author

N67-16655# Army Materials Research Agency, Watertown, Mass.
THE LATTICE PARAMETERS AND SOLUBILITY LIMITS OF ALPHA IRON AS AFFECTED BY SOME BINARY TRANSITION-ELEMENT ADDITIONS
Ernest P. Abrahamson, II and Stanley L. Lopata Aug. 1966 31 p refs
(ARMA-TR-66-25; AD-639663) CFSTI: HC $3.00/MF $0.65

The lattice parameters of alpha iron with binary additions of all the transition metals, except technetium, have been accurately determined on solid samples. No direct correlation with solute size is observed, but an effect of electron configuration is noted. The solubility limits of alpha iron with Ti, Cu, Zr, Nb, Mo, Hf, Ta, and W were determined at 600, 700, 800, and 900 C. (Authors) TAB

N67-16673*# General Electric Co., Cincinnati, Ohio Space Power and Propulsion Section.
CONTAMINATION EXPOSURES OF COLUMBIUM AND TANTALUM ALLOY SPECIMENS Final Report, 25 Feb. 1965–15 Jun. 1966
R. B. Fleming 15 Jul. 1966 135 p refs
(Contract NAS3-4169)
(NASA-CR-54934) CFSTI: HC $3.00/MF $0.65 CSCL 11F

The program described was conducted to determine the oxidation rate, or gettering rate for oxygen, of columbium, zirconium, and tantalum alloy specimens under conditions of low pressures and high temperatures. A total of 15 exposures were conducted with oxygen partial pressures at levels ranging from about 10^{-5} torr to 5×10^{-8} torr, and temperatures at levels of 885°, 950°, 980°, and 1100°C. The gettering rates were established by measuring the pressure drop across a known flow conductance, from which the oxygen gas mass flow rate (equal to the gettering rate) was computed. Data on the pressure directly over the specimen and the gettering rate, were used to calculate the sticking factor (that fraction of total molecules striking the specimen, which do not rebound), which was of primary interest in these experiments. In addition to the 15 exposures, several experiments were conducted to determine various pressure gauge characteristics, and an analysis was made of pressure distribution throughout the system. Author

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N67-15390*# Washington Univ., Seattle. Ceramic Engineering Div.
MULTIDISCIPLINARY RESEARCH ACTIVITY IN THE MATERIALS SCIENCES WITH EMPHASIS ON CERAMIC MATERIALS Semiannual Status Report, Jun. 16–Dec. 15, 1966
James I. Mueller 15 Dec. 1966 37 p refs
(Grant NsG-484)
(NASA-CR-81163; SASR-7) CFSTI: HC $3.00/MF $0.65 CSCL 11B

Summary reports are given on continuing research in the field of ceramics and ceramic engineering, including chemistry, surface phenomena, solid state ceramics, processing, and radiation effects. Topics covered in the investigation of the zirconium–oxygen–carbon system were gas–solid equilibrium, solid–solid equilibrium, calorimetric study of ceramics and related materials, thermodynamics of ternary ceramic phase diagrams, and zirconium oxidation. In the study of solid state ceramics, the areas covered include ferroelectric materials, domain dynamics in isomorphous ferroelectrics, phase topography, Mossbauer studies, defect properties, and mechanisms of deformation. Aluminum oxide bicrystals, surface diffusion, and the use of ceramics in controlling antenna system parameters were studied in the field of surface phenomena. Investigation of the effects of radiation on ceramic materials centered on ultraviolet photolysis of ceramic materials, and processing studies included ceramic processing, sintering of ice, and the effects of lanthanum doping on barium titanate. L.E.W.

N67-15402# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LAMINAR PLASTIC AND GLASS PLASTIC FOR ELECTRICAL INDUSTRY
G. B. Shalon 27 Jun. 1966 43 p refs Transl. into ENGLISH from the Publ. "Sloistyye Plastiki i Stekloplastiki Dlya Elektrotekhnicheskoy Promyshlennosti, Vypusk 7" Leningrad, 1962 p 1–28
(FTD-MT-64-379; TT-66-62494; AD-640723) CFSTI: HC $3.00/MF $0.65

Contents: Brief data on equipment for producing laminar plastics: (1) preparation of binders, (2) impregnation and lacquering of fillers, (3) processing impregnated or varnished fillers; Laminar plastics based on paper and fabric: laminated insulation, electrical textolite, cylinder and tube electrical paper-bakelites; High-strength electric insulating materials - fiber-glass laminates: fiber glass laminate electrical sheet, brand ST, fiber glass laminate STU, heat-resistant fiber glass laminates STK-41 and STK-71, fiber glass laminate STK-41/EP, fiber glass laminate STEF, sheet glass plastic SVAM - a highly durable construction and electric insulating material, rectilinear cutting, figure cutting, sharpening, milling, drilling, flat grinding. TAB

N67-15712*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
CHAR REFLECTANCES AND PLANETARY ENTRY HEAT SHIELDS
R. G. Nagler *In its* Space Programs Sum. No. 37–41, Vol. IV 31 Oct. 1966 p 51–54 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

Described is an optical system to measure the reflectance of pyrolytic graphite and of typical phenolic nylon chars. This scheme uses a three-dimensional gimbal arrangement to allow for angles of incidence of between 33 and 72 degrees through stepwise summation of overlapping spherical polygons. It was found that pyrolytic graphite increases 38% in reflectance between 33 and 73 degrees from normal. Phenolic nylon chars showed an apparent drop in reflectance in the blue (around 0.4μ) wavelength. It is concluded that reflectance techniques may be of value for heat shielding of reentry vehicles, especially since the optical properties of chars are not particularly affected by gross surface roughness, whereas microscopic roughness can vary reflectance as a function of environment. G.G.

N67-15713*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
CARBON AND GRAPHITE
D. B. Fischbach *In its* Space Programs Sum. No. 37–41, Vol. IV 31 Oct. 1966 p 54–57 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

The influence of preferred orientation texture and crystallographic perfection on the mechanical properties of high strength carbon and graphite fibers was analyzed by using stress data obtained on samples of bulk pyrolytic and glassy carbon. Comparison of the Young's modulus of isotropic glassy carbon at 2.5 to 3.5×10^6 psi with that of isotropic pyrolytic carbon at only 1.5×10^6 psi seem to indicate that modulus and strength of isotropic nongraphitizing glassy carbons increases with preferred orientation; cross-linked structures should make better bonding to the matrix in composite materials. Experimental studies established that changes in both preferred orientation texture and crystallite size were greatly accelerated by tensile deformation during graphitization of stressed pyrolytic carbon specimens. G.G.

N67-15714*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
CERAMIC RESEARCH
E. C. de Wys and M. H. Leipold *In its* Space Programs Sum. No. 37-41, Vol. IV 31 Oct. 1966 p 58-61 refs (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

A detailed study of the atomic structure of grain boundaries in magnesium oxide is presented. X-ray defraction micrography on two pressure-sintered polycrystalline magnesium oxide grains established 1.0.0. planes which have an angle of about 7.5 minutes of arc with one another. The boundary region No. 1 appeared to contain a disturbed mosaic crystalline region, the 1.0.0. planes of which made a maximum angle of five minutes of arc with another. Boundary region No. 2 seemed similar except that the related angle was 9 minutes of arc. Mosiacs of a polycrystalline MgO region taken with reflected light microscopy and diffracted X-ray microscopy, respectively, showed that grains 1, 3, and 5 possessed glide planes and silocation loops; grains 2 and 4 apparently responded to stress by polygonizing into parallel substructural regions. Results indicated the presence of large amounts of substructure and disorder in a pure, annealed polycrystalline ceramic. G.G.

N67-15720*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MECHANICAL BEHAVIOR OF SBAR-GLASS BEAD COMPOSITES
R. F. Fedors and R. F. Landel *In its* Space Programs Sum. No. 37-41, Vol. IV 31 Oct. 1966 p 97-107 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

A theoretical model is proposed which attempts to predict both the dependence of the isothermal volume dilatation and the form of the stress-strain relationship on the magnitude of the strain and the concentration of the filler. To prove the validity of the euqations, experimentally measured volume dilation behavior for eight composities with the volume fraction of filler varying from 0.0922 to 0.339 at two temperatures, 23° and 0°C, are reported and compared to the theoretical relationships derived on the basis of the model. Data are also presented on further tests conducted to determine how well the model predicts the uniaxial stress-strain response. M.G.J.

N67-15721*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE SUITABILITY OF THERMOPLASTIC RUBBERS AS A BINDER FOR COMPOSITE SOLID PROPELLANT A Preliminary Report
B. G. Moser and H. Broyles *In its* Space Programs Sum. No. 37-41, Vol. IV 31 Oct. 1966 p 107-109 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

Based on previous experiments, it is postulated that the poor dispersion in thermoplastic rubbers should result in higher burning rates than those found with propellants made from castable and curable rubbers. Efforts therefore concentrated on determining whether this poor dispersion and attendant higher burning rate could be enhanced by plasticizing the rubber system with inert mineral oil. Preparation of the three types of thermoplastic rubber is discussed. Designated as Kraton 101, Kraton 102, and Thermolastic 125, all samples are styrene-butadiene elastomers. A freeze drying technique was used to prepare the specimens without sedimentation. Data are given on the maximum stress and strain of thermoplastic propellants (80% ammonium perchlorate) at room temperature and a strain rate of 0.42 per minute; and on the burning rates of thermoplastic propellants, unplasticized and plasticized, with 5% mineral oil at 1000 psi. In contrast to the Kratons, thermoplastic 125 exhibited the predicted increase in burning rate with the addition of mineral oil. M.G.J.

N67-15722*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
VOLTAGE ENDURANCE TESTS FOR CLOSED-CELL FOAMS
J. Moacanin and J. Ferrar *In its* Space Programs Sum. No. 37-41, Vol. IV 31 Oct. 1966 p 109-111 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

Closed cell polyurethane foams with nominal bulk densities of 2, 4, 6, 8, and 10 lb/ft^3 were tested with a dielectric strength tester in the 60-cycle mode in an effort to determine the high-voltage strength of these foams. The purpose of the study is to present the general relationships for correlating failure times to rate, and to discuss parameters characterizing foams which are expected to be critical in determining their high-voltage endurance. The basic assumption underlying the study is that the extent of damage imparted to a dielectric during a time interval is only a function of voltage V, which is in excess of the discharge inception voltage, V_i. In addition, the total damage necessary to result in failure is a constant k, for a given material. On the basis of previous studies, it appeared that in a foam, discharges will initiate perferentially in larger vodis, i.e., where V_i is lowest. On the basis of this reasoning, it is proposed that this investigation be pursued by assuming that to predict initiation of failure one must consider only what occurs in a single void. An equation was derived by applying extreme value statistics to the problem of dielectric breakdown. Since the distribution of large voids in a foam should also follow the same statistics, this observation suggests a reasonable approach to a theoretical analysis of the problem. The validity of this hypothesis is to be ascertained by extensive experimentation. J.C.W.

N67-15723*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
STUDIES OF STERILIZABLE ELASTOMERS
E. F. Cuddihy and J. Moacanin *In its* Space Programs Sum. No. 37-41, Vol. IV 31 Oct. 1966 p 111-113 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

This study concentrated on the changes of the dynamic-mechanical properties of a sterilizable polybutadiene elastomer during exposure to a temperature of 146°C. With an excess of aziridine curative and in the absence of air, a block copolymer of polybutadiene and a polyaziridine was formed. Continuous exposure to 146°C resulted in the eventual degradation of the polyaziridine and the retention of only the polybutadiene. Elastomers cured in air failed to form block copolymers, indicating that some constituent of the atmosphere, probably oxygen, inhibited the polymerization of the excess aziridine. Author

N67-15787*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
CERAMIC RESEARCH
E. C. de Wys and M. H. Leipold *In its* Space Programs Sum. No. 37-40, Vol. 4 31 Aug. 1966 p 25-26 refs (See N67-15781 06-34) CFSTI: HC $3.00/MF $0.65

A brief report is presented on the continuing research to determine the role of grain boundaries and their associated impurities on the mechanical behavior of magnesium oxide. In studies on preferred orientation, thin sheets of MgO were prepared from sections cut parallel and at 90° to the longitudinal axis of an as-pressed rod (average grain diameter = 5μ), and one in which grain growth had occurred (avarage grain diameter = 160μ). Grain growth conditions were 2160°C for one hour under a gradient of 20° C/cm parallel to the longitudinal axis. No indication of preferred orientation was found in the as-pressed materials. The data indicate that the majority of the [100] poles are confined to a 30° arc from the thermal gradient direction. M.G.J.

N67-15801*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DEGREE OF CROSSLINKING OF STYRENE BUTADIENE RUBBER GLASS BEAD COMPOSITES
R. F. Fedors and R. F. Landel *In its* Space Programs Sum. No. 37-40, Vol. 4 31 Aug. 1966 p 80-83 (See N67-14781 06-34) CFSTI: HC $3.00/MF $0.65

Previous results of equilibrium swelling measurements in benzene indicated that the concentration of effective network chains v_e increased with an increase in volume fraction of filler ϕ. Mechanical behavior studies of these composities showed that v_e was essentially independent of ϕ. Therefore, an analysis is presented on the origin of the error in the value of v_e, calculated from

swelling measurements. The apparent discrepancy in the values obtained for v_ϕ using two independent test methods, is explained on the basis of a breakdown in the models employed in deriving the equations. It is pointed out that the applicability of these equations depends in part on the assumptions: (1) The presence of one particle does not influence the swelling behavior of the binder in the vicinity of neighboring particles. (2) No particle agglomeration or clustering exists. Only the second assumption is considered important and is examined in some detail. It is concluded that for the crosslinked styrene butadiene rubber glass bead composites, the observed increase in the volume fraction of rubber in the swollen gel at equilibrium, with increase in ϕ, is the result of particle agglomeration or clustering. M.G.J.

N67-15805*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
STUDIES ON STERILIZABLE ELASTOMERS
E. F. Cuddihy and J. Moacanin *In its* Space Programs Sum. No. 37-40, Vol. 4 31 Aug. 1966 p 98-103 refs (See N67-15781 06-34) CFSTI: HC$3.00/MF$0.65

The problems involved in preparing sterilizable elastomers from a carboxyl-terminated polybutadiene prepolymer (HC-434) are reviewed. A variety of diimine curatives were used in preparing a series of elastomers. It is reported that a sterilizable elastomer was prepared from HC-434 prepolymer and HX-740 diimine curative. This elastomer cures slowly at 146°C and achieves sterilizability because it continues to cure slowly during the high temperature sterilization. Initial cure period is 1 to 2 days at 146°C. The feasibility of preparing elastomers which cure quickly and preserve properties during sterilization was also demonstrated for an elastomer prepared with a mixed imine curative composed of HX-740 and ZC-466. M.G.J.

N67-15881*# University of Southern Calif., Los Angeles.
[GLASS TRANSITION PHENOMENA] Semiannual Status Report
R. Simha, R. A. Haldon, P. Rawlings, and W. J. Schell 1 Dec. 1966 6 p refs
(Grant NsG-343)
(NASA-CR-81240) CFSTI: HC$3.00/MF$0.65 CSCL 11B

Continuing studies on multiple glass transitions in polymer systems are reported. Length–temperature (L-T) and low frequency dynamic mechanical measurements were taken on a series of polyalkyl methacrylates. The flexible side chain samples were found to exhibit two T_{gg} transitions, and the samples with bulky side groups exhibited only one. A third transition may be associated with absorbed water molecules. Polyinyl methyl, ethyl, and n-butyl ethers were studied in the range −180° to room temperature, and L-H measurements were obtained. The heat capacities were determined for these polymers, up to a side chain length of 18 carbon atoms, with the differential scanning calorimeter. The heat capacity was found to be constant for the methyl and ethyl ether side chain containing polymer, and to increase as the length of the side chain for the high alkyl side chain for the high alkyl side group polymers. Low crystallinity was also investigated with the scanning calorimeter, and cold crystallization was noted at about 140°C. Further work on a hole theory applied to polymer and monomer liquids is mentioned. N.E.N.

N67-15934# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE RHEOLOGY OF A VISCOELASTIC MEDIUM
A. A. Vakulenko and V. M. Chebanov [1966] 5 p refs Transl. into ENGLISH from Mekh. Tverd. Tela. (Leningrad), no. 4, 1966 p 127-129

A scheme is presented to clarify the sphere of operation of the Boltzmann superposition principle. This is applied to real materials whose behavior during deformation processes is viscoelastic to a sufficient degree. Some test results are included. Author

N67-16073# Naval Air Engineering Center, Philadelphia, Pa. Aeronautical Materials Lab.
REACTIVATION OF CHROMATED CONVERSION COATINGS FOR MAXIMUM PAINT ADHESION Progress Report
Peter J. Sabatini 7 Sep. 1966 16 p ref
(NAEC-AML-2503; AD-640901) CFSTI: HC$3.00/MF $0.65

Aircraft manufacturers have had considerable difficulty with adhesion of the epoxy paint system to aged chromated aluminum surfaces. This report presents results of an investigation of various methods to reactivate such surfaces and recommends several procedures that were effective in improving paint adhesion. Author (TAB)

N67-16087*# Case Inst. of Tech., Cleveland, Ohio. Polymer Science Group.
FUNDAMENTAL STUDIES FOR THE DEVELOPMENT OF POLYETHYLENE TEREPHTHALATE AS A CYROGENIC LINER MATERIAL Semiannual Report
Oct. 1966 43 p refs
(Grant NGR-36-003-054)
(NASA-CR-80922) CSCL 11I

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3. INFRARED STUDIES OF SOLVENT INDUCED CRYSTALLIZATION PART III J. L. Koenig and B. Hickle p 31-37 (See N67-16091 06-18)

N67-16088*# Case Inst. of Tech., Cleveland, Ohio. Polymer Science Group.
MECHANICAL RELAXATION BEHAVIOR OF PET FROM 4.2°K TO 280°K, PART I
I. Kuriyama and Eric Baer *In its* Fundamental Studies for the Develop. of Polyethylene Terephthalate as a Cryog. Liner Mater. Oct. 1966 p 1-16 refs (See N67-16087 06-18)

The relaxation processes in polyethylene terephthalate (PET) were investigated at liquid helium to room temperature. The relaxation processes occurring between 4° and 90°K were emphasized since these molecular motions might be important in understanding and improving the ductility of these materials at liquid hydrogen temperatures. Consideration is given to the calculation of shear and loss moduli, reproducibility of data, and preparation and crystallinity measurements. The temperature dependence of the shear and loss moduli was studied with samples ranging in crystallinity from 3.5 to 64%. Three new relaxation maxima, referred to as γ, δ, and T, were observed at 105°, 41°, and 20°K. Although the shape of the γ and δ peak tend to sharpen appreciably with crystallinity, the peak maxima remained fairly constant. However, initial results indicated that T peak is measurably affected by crystallinity. It was also found that orientation has a significant effect on the mechanical relaxation spectra of PET. Biaxial orientation substantially sharpened the relaxation maxima and produced a splitting of the β and δ peaks. L.E.W.

N67-16089*# Case Inst. of Tech., Cleveland, Ohio. Polymer Science Group.
MORPHOLOGY OF PET, PART II
G. Yeh and P. H. Geil *In its* Fundamental Studies for the Develop. of Polyethylene Terephthalate as a Cryog. Liner Mater. Oct. 1966 p 17-30 (See N67-16087 06-18)

The morphology of polyethylene terephthalate (PET) was studied, with primary emphasis placed on the morphology of the glass and the effect of strain-induced crystallization of the polymer. PET crystallized from solution in the form of chain-folded fibrillar

ribbons. The morphology of the glassy state is characterized by 75 A ball-like structures in which the molecules are packed with some order. Crystallization from glassy amorphous PET occurs by the formation of spherulites consisting of ribbon-like lamellae. The long period increases as measured by small angle X-ray scattering with annealing temperature but it decreases with time at a given annealing temperature. An interpretation is given for this decrease of long period with time. Strain-induced crystallization of PET occurs by alignment of the ball-like structures. Subsequent heat treatment of the strained material produces more complete alignment of the ball-like structures as well as perfection in the chain packing within the structures. A special technique was developed to investigate the details of the morphology of oriented PET. Author

N67-16090*# Case Inst. of Tech., Cleveland, Ohio. Polymer Science Group.
INFRARED STUDIES OF SOLVENT INDUCED CRYSTALLIZATION, PART III
J. L. Koenig and B. Hickie *In its* Fundamental Studies for the Develop. of Polyethylene Terephthalate as a Cryog. Liner Mater. Oct. 1966 p 31–37 (See N67-16087 06-18)

The effects of solvent and dip time on the crystallinity of polyethylene terephthalate (PET) and mylar samples were investigated. Acetone and toluene were used as solvents because of previously obtained results on the rate of induced crystallization and because of their low boiling points for easier drying. Sample preparation is described, and results are presented in graph form. It was found that the amount of solvent-induced crystallinity depends on the dip time or the amount of solvent in the amorphous film. The time-dependent increase in crystallinity in presence of solvent hit below the glass transition was similar to the time-dependent behavior of heat-induced crystallinity at temperatures above the glass transition in the absence of solvent. Acetone-dipped films had a slightly higher crystallinity for equivalent dip times than toluene-dipped films. The amount of solvent-induced crystallinity in commercial mylar samples was considerably lower due to the high initial crystallinity. L.E.W.

N67-16121# Naval Civil Engineering Lab., Port Hueneme, Calif.
REINFORCED PLASTICS AS STRUCTURAL MATERIALS
R. A. Breckenridge, L. R. Russell, and C. K. Paul Nov. 1966 59 p refs
(R-491; AD-642097) CFSTI: HC $3.00/MF $0.65

A survey was made of existing knowledge regarding the use of reinforced plastics as the load-carrying members in structural systems. Examples are given of existing applications in large buildings, motels, houses, special uses marine surface craft, deep submersible hulls, and in other areas. A review is made of structural shapes that are commercially available. The basic materials, i. e., resins and reinforcements, are briefly discussed, and the various methods of combining them into a finished item are mentioned. The physical properties are summarized, and the areas of potential degradation are discussed. Problems in the design of reinforced plastics are considered. The areas in which there appears to be good potential for increased structural applications are presented; those that might be of greatest interest to NFEC include (1) antenna-support systems, (2) waterfront structures and facilities, (3) structures in remote areas that require shipping or that present maintenance problems, and (4) advanced-base structures that must be built under the pressure of military exigency. Author (TAB)

N67-16128# Union Carbide Corp., Bound Brook, N. J. Research and Development Dept.
COMPOSITE THERMOPLASTIC/GLASS FILAMENT REINFORCEMENT FOR BUOYANT SUBMARINE CABLES RG-372 (XN-1)/U AND RG-373 (XN-1)/U Interim Report, 10 Sep.–10 Nov. 1966
P. H. Hofer, H. J. Nalepa, and W. H. Zager 10 Nov. 1966 25 p
(Contract NOO-140-66-C-0403)
(IR-3; AD-642093) CFSTI: HC $3.00/MF $0.65

An investigation was made to develop a composite thermoplastic/glass filament reinforcement for buoyant submarine cables, and to design, develop and fabricate experimental and test models of wire and cables in 2000 foot lengths for use in improved floating wire submarine antenna systems. A new type glass tire-cord, with 3 strands, is somewhat stronger than the old 5 strand cord and has a significantly improved flex life. Its properties will be used as the new bench mark. To permit watertight packing of the impregnated tensile members, it may be necessary to start with wire-like, cylindrical shapes. From initial trials, it appears that the ribbon-like shapes, which are currently produced, can be converted into cylinders with the use of a roll-forming operation. No additives investigated to date significantly improved the properties of the polyurethane impregnated tensile members. Additives included coupling agents, Phenoxy, polysulfone, and a polyethylene interpolymer adhesive. No further work with additives is planned. TAB

N67-16158# Naval Ordnance Lab., White Oak, Md.
THE EFFECT OF EPOXY RESIN AND CURING AGENT STRUCTURE ON ABLATIVE PROPERTIES Interim Report, Jul. 1964–Jul. 1965
Gerald J. Fleming 12 Sep. 1966 32 p refs
(NOLTR-66-124; AD-641179) CFSTI: HC $3.00/MF $0.65

The reported is the second phase of a correlation of the chemical and physical properties of a polymer with its ablative properties (See AD-467 049 for phase I). Epoxide resins and curing agents were employed as model systems. Thermogravimetric analysis, cross-link density studies, infrared spectroscopy and alpha-rod testing in the oxyacetylene burner facility were employed in the evaluation of the various systems. Amine cured epoxide structures produced high char rates (7.1 to 21.0 mils/sec) and low times to 200C (33 to 47 sec). Certain anhydride cured epoxides, namely methyl bicyclo (2.2.1) heptene-2,3-dicarboxylic anhydride (NMA) and 3,3,4,4-benzophenone tetracarboxylic dianhydride (BTCD) were found to give good performance with low char rates (2.2 to 5.0 mils/sec) and high times to 200C (91 to 101 sec). Epoxides with a polyphenyl backbone gave the best overall performance, although resorcinol diglycidyl ether performed well also. Resin purity was found to be fairly critical in regard to ablative performance. Author (TAB)

N67-16215# Naval Air Engineering Center, Philadelphia, Pa. Aeronautical Materials Lab.
CONDUCTIVE TRANSPARENT THERMOPLASTIC FILMS Progress Report, 1 Jul. 1965–30 Jun. 1966
I. H. Custis 30 Jun. 1966 13 p refs
(PR-2; AD-640273) CFSTI: HC $3.00/MF $0.65

Progress in developing conductive transparent thermoplastic materials by using internal antistatic agents, is reported. A test procedure for evaluating the electrostatic properties was developed and is described. Author (TAB)

N67-16256# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
A STUDY ON STRIPPABLE VARNISHES USED IN THE PROTECTION OF SURFACES AGAINST RADIOACTIVE CONTAMINATION [BADANIE LAKIEROW ZDZIERALNYCH DO OCHRONY POWIERZCHNI PRZED SKAZENIAMI PROMIENIOTWORCZYMI]
A. Siemaszko, J. Siejka, M. Nowak, and J. Stolarz *In its* Nukleonika, Vol. VIII 1966 p 241–245 refs (See N67-16221 06-06)
CFSTI: HC $3.00/MF $0.65

Radioactive isotope permeability, radioactive contamination, and strippability were tested for a varnish consisting of vinyl chloride copolymer, polyvinyl alcohol, and maleic acid. Various

thicknesses of protective coating were applied to glass, ceramics, unpainted metal, and enameled metal samples and exposed to aqueous solutions of the radioisotopes ^{137}Cs and ^{144}Ce. A 12-micron film of varnish let only 0.5% of radioactivity through after exposure for 64 hours; layers from 25 microns provided total protection against contamination. The varnish itself contaminated poorly and achieved a state of adsorption equilibrium very quickly. Unsatisfactory strippability was displayed by plexiglass, nitro laquer, and vinyleum; this was attributed to the reaction of the varnish thinner with these materials. It was concluded that the above described varnish was suitable for protecting surfaces of metal, wood, glass, ceramics, and other surfaces sensitive to moisture.
G.G.

N67-16373# State Univ. of New York, Stony Brook.
MECHANISMS OF ATTACK ON GLASSES IN AQUEOUS MEDIA Interim Scientific Report, 1 Jun.–20 Sep. 1966
Sumner N. Levine and William C. LaCourse 20 Sep. 1966 70 p refs
(Contract Nonr-4803(00))
(AD-641500) CFSTI: HC $3.00/MF $0.65

As part of a program concerned with the influence of surface properties of glass on the behavior of reinforced plastics, we report here on an electron microscope study of aqueous attack on glass. Micrographs of E and 994 glasses, treated in solution of pH 2 through 11, are shown and a discussion of these micrographs is given. The effects of large scale phase separation in these glasses are discussed and plausible mechanisms for aqueous attack on these glasses are given. A detailed discussion of glass structure and a survey of earlier work on chemical attack is given in the introduction. An alternative approach to the boric oxide anomaly is also suggested.
Author (TAB)

N67-16422# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE USE OF OPTICALLY ACTIVE COATINGS IN THE SOLUTION OF PLANE ELASTO–PLASTIC PROBLEMS
A. F. Mozhanskaya, A. P. Fedorov, and N. A. Flerova 13 Apr. 1966 11 p refs Transl. into ENGLISH from Sudostroyeniye (Leningrad), no. 1, 1965 p 21–23
(FTD-TT-65-1991; TT-66-62564; AD-641649) CFSTI: HC $3.00/MF $0.65

The tests conducted permitted the development of a prescription and of a technology for the preparation of an optically active coating of epoxy resins of the EDP and EDL brand, with a maximum relative deformation of 6 - 7%. On the basis of a study of the relaxation properties of materials obtained from modified epoxy resins, optimum prescriptions are presented for research of deformation of the order of 10 - 12%. The possibility of the utilization of polyethyl carbamate as a photoelastic coating is shown. A composition of cold hardening glue was developed which provides a satisfactory adherence of the epoxy and the polyethyl carbamate coating to various materials.
Author (TAB)

N67-16425# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
THE EFFECT OF HIGH PRESSURE ON B_2O_3: CRYSTALLIZATION, DENSIFICATION AND THE CRYSTALLIZATION ANOMALY
D. R. Uhlmann, J. F. Hayes, and D. Turnbull Jul. 1966 54 p refs
(Contracts Nonr-1866(50); ARPA SD-88)
(TR-8; AD-641324) CFSTI: HC $3.00/MF $0.65

The crystallization and densification of B2O3 at high pressure were investigated using a Bridgman anvil device. Crystallization was observed at pressures as low as 4 kilobars and at temperatures as low as 210C. A marked effect of water in increasing the overall crystallization rate, and the increase in this rate with increasing temperature, were demonstrated. Increases in density as large as 17 per cent, and a strong effect of temperature in increasing densification, were likewise shown. The crystallization behavior is discussed in terms of the kinetic formalism developed previously and is related to past observations on SiO2 at high pressure. The densification results are considered in light of the results of others workers on B2O3 and SiO2. The anomalous crystallization behavior of B2O3 is discussed, and a number of hypotheses are advanced to explain the observations. These hypotheses are evaluated in relation to the results of the high pressure study.
Author (TAB)

N67-16452# Pennsylvania State Univ., University Park. Materials Research Lab.
RELATION OF MECHANICAL PROPERTIES TO THE STRUCTURE OF IONIC SOLIDS Quarterly Report, 1 Jun.–31 Aug. 1966
K. Vedam and V. Vand Watertown, Mass., Amry Mater. Res. Agency, 14 Sep. 1966 41 p refs
(Contract DA-19-066-AMC-325(X))
(AMRA-CR-66-07/1; QR-1; AD-641911) CFSTI: HC $3.00/MF $0.65

The primary objective of this project is to strive towards the goal of an ideal ductile ceramic (i) by carrying out investigations on the various mechanical properties of different mica species (ii) by determining the crystal structure of some of these selected micas and correlating the results with their mechanical properties and (iii) by tailor-making suitable materials from a knowledge of the mechanism responsible for the unique mechanical properties of mica. An extensive bibliography on the various physical properties of mica and its synthesis and crystal growth is included.
Author (TAB)

N67-16463# Denver Research Inst., Colo.
RESPONSE OF NON-WOVEN SYNTHETIC FIBER TEXTILES TO BALLISTIC IMPACT Final Report, Jul. 1963–Oct. 1965
Thomas W. Ipson and Edward P. Wittrock Natick, Mass., Army Natick Labs., Jul. 1966 125 p refs
(Contract DA-19-129-AMC-157(N))
(TR-67-8-CM; TS-142; AD-641433) CFSTI: HC $3.00/MF $0.65

The objective of this program was to define the transient behavior of the felt and the force interaction between it and the projectile. Six felt samples (nylon (3), orlon, dacron, polypropylene) were tested using the 17-grain fragment simulating projectile at various velocities up to and greater than the ballistic limit velocity. Graphical differentiation was used to obtain velocity-time, force-time, and force-distance relationships. Qualitative evaluations reveal that strength, elongation, and transverse wave velocity are the three predominant parameters in determining effectiveness. The energy absorbed by a felt is maximum at the ballistic limit velocity and decreases dramatically at higher (complete perforation) velocities. An analytical model based upon momentum considerations is compared to the experimental results.
Author (TAB)

N67-16470# Picatinny Arsenal, Dover, N. J. Plastics Technical Evaluation Center.
SUBJECT INDEX, BIBLIOGRAPHY, AND CODE DESCRIPTION OF TECHNICAL CONFERENCE PAPERS ON PLASTICS: 5 MARCH 1965–10 MARCH 1966
Joan B. Titus and Arnold E. Molzon Jul. 1966 137 p refs
(PLASTEC-27; AD-641666) CFSTI: HC $3.00/MF $0.65

The papers presented at technical conferences on plastic materials and related technology, within a one year period ending 10 March 1966 are listed, indexed by subject, and compiled by material, type of technical data, and military application. Over 690 papers from 20 conferences are covered. Included are a

bibliography, author index, summary of new material developments, and a list of applications and programs sponsored by the Department of Defense and the National Aeronautics and Space Administration. Author (TAB)

N67-16496# Coating and Chemical Lab., Aberdeen Proving Ground, Md.

A STUDY ON ELECTRODEPOSITION OF ORGANIC COATINGS FOR POSSIBLE MILITARY USAGE Final Report

J. Frauenhoffer and William H. Deaver Oct. 1966 26 p refs

(CCL-209; AD-641314) CFSTI: HC $3.00/MF $0.65

A brief discussion on the electrodeposition of organic coatings is presented as the result of an extensive literature survey through recent technical journals and publications. The feasibility of the process for possible military usage was studied using a specific proprietary coating. Laboratory work on processing parameters indicated that electrodeposition would offer advantages for uniformly coating equipment with complex configurations which cannot be adequately coated by other application methods. Before this process can be extensively used more technical data on electrocoating mechanisms suitable vehicles, pigments, additives, formulation parameters and means for effectively maintaining a uniform composition during electrocoat processing will have to be developed so that the quality of the deposited films can be controlled. Author (TAB)

N67-16677*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

PERFORMANCE OF THREE ABLATION MATERIALS DURING SIMULATION OF LONG-DURATION AFTERBODY HEATING

Marvin B. Dow and Stephen S. Tompkins Washington, NASA, Jan. 1967 35 p refs

(NASA-TM-X-1330) CFSTI: HC $3.00/MF $0.65 CSCL 11D

An experimental investigation was made to determine the resistance to heat penetration and deformations or buckling of three ablation materials during simulated exposure to lifting-vehicle afterbody-heating conditions. The ablation materials, which were bonded to inconel cones, were subjected to convective heating at cold-wall heating rates ranging from 4 to 40 Btu/ft^2-sec (45 to 455 kW/m^2) in arc-jet streams of air and nitrogen. The ablation materials tested were a molded epoxy-based composite and a silicone elastomeric with and without honeycomb reinforcement. For the test conditions of the investigation, models with the epoxy-based composite and the unreinforced silicone elastomeric developed buckles in the ablation material; two models of the epoxy-based composite failed catastrophically. The honeycomb reinforcement in the silicone elastomeric was beneficial in restraining thermal expansion and maintaining char integrity. Except for tests in nitrogen, the silicone elastomerics provided the best resistance to heat penetration. Author

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N67-15358# RAND Corp., Santa Monica, Calif.

A TEST FOR THE INDEPENDENCE OF TWO RENEWAL PROCESSES

Sidney C. Port and Charles Stone Sep. 1966 17 p refs

(Contract AF 49(638)-1700; Proj. RAND)

(RM-5124-PR; AD-640269) CFSTI: HC $3.00/MF $0.65

This study develops a large sample test for the independence of two renewal processes. Such a test should be useful in connection with certain neurophysiological experiments and in reliability and maintenance procedures for stochastically failing equipment. Author (TAB)

N67-15405# Massachusetts Inst. of Tech., Cambridge. Dept. of Physics.

PAULI ALGEBRA AND THE STRUCTURE OF THE LORENTZ GROUP

Laszlo Tisza and Cynthia Kolb Whitney [1966] 43 p refs

(Contract Nonr-3963(24))

(AD-639651) CFSTI: HC $3.00/MF $0.65

The set of two-by-two complex matrices, called the Pauli algebra, is developed systematically for a variety of applications. In addition to the usual concepts, the authors discuss matrices which are normal (as a generalization of unitary or Hermitian), introduce the concept of complex matrix axis, and provide a so-called polar decomposition for any nonsingular matrix. As a first application, they discuss the homogeneous restricted Lorentz group. The parametrization here advanced for unimodular two-by-two matrices provides directly the geometrical meaning of the Lorentz transformation induced by any such matrix. The discussion is exhaustive and includes matrices which induce the so-called exceptional Lorentz transformations. Author (TAB)

N67-15415# Lockheed Missiles and Space Co., Sunnyvale, Calif.

A TABLE OF PERIODIC CONTINUED FRACTIONS

R. Kortum and G. McNiel [1966] 1500 p refs

(AD-640524) CFSTI: HC $3.00/MF $0.65

The table gives the following information for each positive non-square integer $D < 10{,}000$: a) the first half period of the partial quotients q_k for the continued fraction expansion of $D^{1/2}$, b) the first half period of the denominators of the complex quotients Q_k for the continued fraction expansion of $D^{1/2}$, c) an indication when D is of the form $N^2 + 1$, d) the parity of the period p for the continued fraction expansion of $D^{1/2}$, e) the fundamental solution to Pell's equation $x^2 - Dy^2 = -1$ when the parity of p is even, f) the fundamental solution to the equation $x^2 - Dy^2 = -1$ when the parity of p is odd, and g) the ratio p^2/D correct to nine significant figures whenever this ratio exceeds one. The entire table was computed on the IBM 7090 digital computer in 36 minutes. The program for the table is designed to compute all the information above for any given positive non square integer D less than 150 million. Author

N67-15554*# National Aeronautics and Space Administration, Washington, D. C.

THE PHENOMENA THAT OCCUR IN THE NEIGHBORHOOD OF A TIME LINE [SOPRA I FENOMENI CHE AVVENGONO IN VICINANZA DI UNA LINEA ORARIA]

E. Fermi Oct. 1966 11 p refs Transl. into ENGLISH from ITALIAN

(NASA-TT-F-10356) CFSTI: HC $3.00/MF $0.65 CSCL 12A

Geometric observations are considered to find appropriate reference for the study of phenomena occurring in the neighborhood of a time line. Analytic expressions are found for the operations indicated by a Riemann manifold, and covariant and contravariant coordinates are expressed. It is stated that two contravariant components are obtained by multiplying their magnitude by the contravariant coordinates of the tangent to L. An equation is derived which gives a system of first-order differential equations for n unknown quantities. A hypothesis is formed for infinitely neighboring relationships valid in the neighborhood of L: the neighborhood of L is extended to a Euclidean space. Physical applications of the results obtained are extended to the theory of relativity, and by integrating equations the electromagnetic field is determined. Author

N67-15775# Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics.

CERTAIN DEVICES FOR THE NUMERICAL TREATMENT OF ORDINARY DIFFERENTIAL EQUATIONS

Henry L. Langhaar Oct. 1966 53 p refs
(Grant NSF GK-604)
(T&AM-293; TR-1)

Four topics are treated: (1) the use of a polynominal extrapolation formula to link various formulas of numerical differentiation; (2) the use of the extrapolation formula to supply the needed extra boundary conditions when ordinary differential equations are approximated by difference equations of higher order; (3) the use of closed solutions of difference equations in particular cases to distinguish the errors inherent in the finite-difference approximations from inaccuracies due to roundoff, and to verify convergence; and (4) the use of real truncated Dirichlet series in conjunction with the method of least squares to approximate attenuating solutions of differential equations over infinite intervals. Examples of numerical differentiation, boundary-value problems, and eigenvalue problems of various degrees of complexity are examined to test the capability of these methods. Author

N67-15935# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE QUESTION OF THE SOLUTION OF A DIFFERENTIAL EQUATION OF THE FORM $\ddot{x} + p(t)x = 0$
V. P. Chirkin [1966] 5 p refs Transl. into ENGLISH from Prikl. Mekh., Akad. Nauk Ukr. SSR (Kiev), v. 2, no. 9, 1966 p 119–123

Various approaches are discussed for solving this differential equation, in which p(t) is some continuous function expandable in a Maclaurin series. One solution is found by the transition to equivalent Volterra integral equations. An exact solution may be obtained by the classical method of successive approximations. It is pointed out, however, that technical difficulties impede finding the iteration, starting with the third approximation. A method is presented for finding the m-th iteration of the kernel, and of the corresponding resolvent. M.G.J.

N67-15969# California Univ., Los Angeles. Western Management Science Inst.
ON COMPUTING THE EXPECTED DISCOUNTED RETURN IN A MARKOV CHAIN
David F. Hitchcock and James B. MacQueen Aug. 1966 15 p refs /Its Working Paper No. 105
(Contract Nonr-233(75))
(AD-641193) CFSTI: HC $3.00/MF $0.65

The discounted return associated with a finite state Markov chain X sub 1, X sub 2... is given by g(X sub 1) + alpha 2g(X sub 3) + ..., where g(x) represents the immediate return from state x. Knowing the transition matrix of the chain, it is desired to compute the expected discounted return (present worth) given the initial state. This type of problem arises in inventory theory, dynamic programming and elsewhere. Usually the solution is approximated by solving the system of linear equations characterizing the expected return. These equations can be solved by a variety of well-known methods. This paper describes yet another method, which is a slight modification of the classical iterative scheme. The method gives sequences of upper and lower bounds which converge monotonely to the solution. Hence, the method is relatively free of error control problems. Computational experiments were conducted which suggest that for problems with a large number of states, the method is quite efficient. The amount of computation required to obtain the solution increases much slower with an increase in the number of states, N, than with the conventional methods. In fact, computational time is more nearly proportional to N2, than to N3. Author (TAB)

N67-16010*# Rochester Univ., N. Y.
LYAPUNOV FUNCTIONS FOR A CLASS OF n^{th} ORDER NONLINEAR DIFFERENTIAL EQUATIONS
Edwin Kinnen and Chiou Shiun Chen Washington, NASA, Jan. 1967 31 p refs
(Grant NsG-574)
(NASA-CR-687) CFSTI: HC $3.00/MF $0.65 CSCL 12A

A method is described for sequentially developing a quadratic polynomial into a possible Lyapunov function for a class of nonlinear differential equations. The equations are n^{th} order in one dependent variable, with nonlinearities appearing as polynomial functions of the variable and its n−1 derivatives. The procedure utilizes higher order homogeneous polynomials in the dependent variable and its derivatives to generate sign definite functions. Author

N67-16036# Research Triangle Inst., Durham, N. C.
CENTRAL LIMIT THEOREMS FOR WEAKLY STATIONARY SEQUENCES
R. J. Serfling Sep. 1966 22 p refs
(Contract DA-31-124-ARO(D)-323)
(TR-1; AROD-5506-1; AD-641228) CFSTI: HC $3.00/MF $0.65

Analysis of stochastic processes often involves weakly stationary sequences of random variables. The usefulness of central limit theory in inference based upon large samples of independent variables encourages efforts to carry it over to such sequences of dependent variables. The specialization of a theorem of Hoeffding and Robbins to weakly stationary and m-dependent sequences is generalized herein to a wide class of weakly stationary sequences. Various ways of restricting dependence are discussed. Strigent conditions such as strict stationarity and strong mixing are not assumed, so wide applicability is possible. Author (TAB)

N67-16037# Research Triangle Inst., Durham, N. C.
LARGE SAMPLE TESTS FOR SPECTRAL DENSITIES
Jonathan D. Cryer Sep. 1966 9 p refs
(Contract DA-31-124-ARO(D)-323)
(SU-207; AROD-5506-2; TR-2; AD-641229) CFSTI: HC $3.00/MF $0.65

A family of statistics is proposed for the problem of testing the hypothesis that the sample X sub t, $0 < t < T$, is from a stationary stochastic process with a given covariance function or spectral density. Author (TAB)

N67-16038# McGill Univ., Montreal (Quebec).
CERTAIN STUDIES ON THE MULTIVARIATE LOGARITHMIC SERIES DISTRIBUTION Interim Report, Jul. 1965–Jan. 1966
Sheela Bildikar (Pa. State Univ.) and Ganapati P. Patil Wright-Patterson AFB, Ohio, ARL, Jul. 1966 49 p refs Prepared in Cooperation with Pa. State Univ.
(Contracts AF 33(657)-11559; AF 33(615)-2763)
(ARL-66-0148; AD-641018) CFSTI: HC $3.00/MF $0.65

The following aspects of the multivariate logarithmic series distribution are studied: The distributions related to the multivariate logarithmic series distribution including its marginal and conditional distributions, moment properties and the moments problem, some regression and correlation analysis, location of the mode, estimation of parameters by the methods of maximum likelihood and unbiased minimum variance. At the end, an application of the multivariate logarithmic series distribution in the field of population and community ecology is discussed. Author (TAB)

N67-16066*# Raytheon Co., Alexandria, Va. Autometric Operation.
RESEARCH ON LINEAR SYSTEMS OF A VERY LARGE SIZE Scientific Status Report, 6 May–30 Sep. 1966
24 Oct. 1966 16 p refs
(Contract NASw-1421)
(NASA-CR-81259; CR-66-198-1) CFSTI: HC $3.00/MF $0.65 CSCL 12A

The topological characteristics of the matrix A in the equation $y = Ax$ have been studied in a search for parameters which would be described in the discrete topology of A^T and which could be traced through successive transformations. The properties of A, A^TA, and $(A^TA)^{-1}$ as continuous (infinite) matrices have been studied with an eye to relating the maxima and minima of A to those of A^TA and $(A^TA)^{-1}$. Finally, studies have been made

of known procedures to see if these can be modified or new approaches found which will give solutions in a smaller number of steps. This work has led to derivation of two iterative procedures which are so different from each other that they are discussed separately. A supplementary bibliography is also included. Author

N67-16113# RAND Corp., Santa Monica, Calif.
EQUILIBRIUM SYSTEMS FOR STABLE PROCESSES
Sidney C. Port Sep. 1966 29 p refs
(Contract AF 49(638)-1700)
(RM-4964-PR; AD-641329) CFSTI: HC $3.00/MF $0.65

Results are presented of an investigation of several phenomena connected with the movement of particles through a compact subset B of d-dimensional Euclidean space in a system of infinitely many particles in statistical equilibrium, where each particle moves independently of the others according to the laws of the same symmetric stable process. Author (TAB)

N67-16118# McGill Univ., Montreal (Quebec).
STOCHASTIC AND SAMPLING PROCESSES FOR THE LOGARITHMIC SERIES DISTRIBUTIONS Scientific Interim Report, Jul. 1965–Jan. 1966
Ganapati P. Patil and Richard W. Shorrock Jul. 1966 90 p refs
Prepared in Cooperation with Pennsylvania State Univ., University Park
(Contracts AF 33(657)-11559; AF 33(615)-2763)
(ARL-66-0147; AD-640951) CFSTI: HC $3.00/MF $0.65

In the present report several stochastic and sampling processes leading to the logarithmic series distribution and some related distributions were studied. An attempt was made to present a unified picture, using a single notation, of the various derivations and approaches that appear in the literature. These derivations and approaches are compared and some of the relationships among them are brought out. Though the work is mainly interpretative, there are a few results that seem to be new. Author (TAB)

N67-16119# Illinois Univ., Urbana. Coordinated Science Lab.
A STUDY OF SYSTEM RELIABILITY USING TOPOLOGICAL METHODS
Glenn H. Stumpff Aug. 1966 113 p refs
(Contracts DA-28-043-AMC-00073(E); AF 33(608)-1237)
(R-300; AD-639703) CFSTI: HC $3.00/MF $0.65

This dissertation is primarily concerned with monotonic or coherent systems which operate whenever one or more subsets of their elements operate simultaneously. The algebraic structure of the system reliability function, R sub s, when written in terms of the variables representing the reliabilities of elements in the system, is investigated. In particular -- for systems having reliability models which can be represented by weighted linear graphs or nets, and for which the subsets of simultaneously operating elements correspond to paths between two nodes of the net -- a number of interesting relationships between R sub s and the topology of its corresponding net are proven. TAB

N67-16151# Carnegie Inst. of Tech., Pittsburgh, Pa. Graduate School of Industrial Administration.
OPTIMAL TRANSPORTATION BASES
Wieslaw Grabowski and Wlodzimierz Szwarc Jul. 1966 50 p refs *Its* Management Sci. Res. Rept.-80
(Contract Nonr-760(24))
(AD-640668) CFSTI: HC $3.00/MF $0.65

The paper deals with transportation cost matrices which possess a certain specific property referred to as Property A. Theorems are supplied which help to characterize such matrices. A method of solving the classical transportation problem is presented, as based on what are presently called optimal transportation bases. In this method finiteness is guaranteed by using a special perturbation technique on the cost matrix which is to be transformed into some cost matrix of property A. Several properties of optimal bases of cost matrices possessing property A are also examined and theorems on the number of such bases are supplied. In the concluding section some comparisons between the OBM and the classical primal transportation method are made. Author (TAB)

N67-16190# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
ON A PRIORI ESTIMATES OF THE FIRST DERIVATIVES OF SOLUTIONS OF THE DIRICHLET PROBLEM FOR QUASILINEAR ELLIPTIC EQUATIONS IN AN UNBOUNDED DOMAIN
A. P. Oskolkov and V. A. Tarasov 12 Sep. 1966 11 p refs
Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Mat., Mekh. i Astron. (Leningrad), no. 7, 1966 p 58–62
(Contract NOw-62-0604-c)
(TG-230-T500; AD-642623) CFSTI: HC $3.00/MF $0.65

Translation of Russian Research: On a priori estimates of the first derivatives of solutions of the Dirichlet problem for quasilinear elliptic equations in an unbounded domain. TAB

N67-16195# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.
TAUBERIAN TRANSLATION ALGEBRAS
John J. Benedetto Mar. 1966 51 p refs
(Contract Nonr-595(17); Grant NSF GP-4921)
(BN-441; AD-640751) CFSTI: HC $3.00/MF $0.65

In this paper the author extends the translation of convolution property of L(1) (that is, tau (f*g) = tau f*tau g) to more general topological algebras, and determine conditions under which the closure of the set of translates of an element is the whole algebra. Applications of this procedure to algebras of distributions and for approximating elements of an algebra by differential polynomials (of a given element) serve as motivation for such a generalization; along with the observation of the importance in proving Tauberian results of Weiners theorem on the inversion of absolutely convergent Fourier series. TAB

N67-16210# Ballistic Research Labs., Aberdeen Proving Ground, Md.
NUMERICAL COMPUTATION OF THE DISTANCE FROM A POINT TO AN ELLIPSOID
Aviars K. Celmins and William J. Sacco Aug. 1966 22 p refs
(BRL-R-1328; AD-641011) CFSTI: HC $3.00/MF $0.65

A problem of current interest in weapon evaluation studies at the Ballistic Research Laboratories requires an efficient method for computing the distance from an arbitrary point in space to a given ellipsoid. Two techniques for performing the calculation are proposed in the report. Author (TAB)

N67-16328# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
ON SOME APPLICATIONS OF AN INTEGRATED FOURIER SERIES
V. V. Zhuk 29 Sep. 1966 12 p refs Transl. into ENGLISH from Vestn., Ser. Mat., Mekhan. i Astron. (Leningrad), no. 7, 1966 p 29–34
(TG-230-T499; AD-642622) CFSTI: HC $3.00/MF $0.65

The problem of absolute convergence of Fourier series and of uniform convergence factors is considered. A theorem on the estimation of Fourier coefficients under the condition that they are positive is proved. Author (TAB)

N67-16347# Illinois Univ., Urbana.
MEASURE ALGEBRAS AND SPECTRAL REPRESENTATIONS
W. Fairchild May 1966 27 p refs
(Contract DA-31-124-ARO(D)-288)
(AROD-5254-10; AD-641576) CFSTI: HC $3.00/MF $0.65

Spectral families of measures and a spectral representation theorem are presented and examined. Author (TAB)

N67-16350# Harvard Univ., Cambridge, Mass. Dept. of Statistics.
UPPER AND LOWER PROBABILITY INFERENCES BASED ON A SAMPLE FROM A FINITE UNIVARIATE POPULATION
A. P. Dempster 10 Oct. 1966 43 p refs
(Contract Nonr-1866(37))
(TR-14; AD-641130) CFSTI: HC $3.00/MF $0.65

Detailed formulas are provided for upper and lower probability inferences, based on a sample from an unknown finite population with a discrete univariate characteristic, and directed towards parameters of the population or properties of a future sample. Author (TAB)

N67-16367# Brandeis Univ., Waltham, Mass.
ALGEBRAIC, ANALYTIC AND DIFFERENTIABLE STRUCTURES Final Report, 14 Dec. 1962–30 Sep. 1966
Richard S. Palais, Joseph J. Kohn, and Hugo Rossi 16 Sep. 1966 6 p refs
(Grant DA-ARO(D)-31-124-6401)
(AROD-3965-1; AD-642158) CFSTI: HC $3.00/MF $0.65

The research herein reported was centered about the following problem: To obtain regularity theorems for the tangential Cauchy-Riemann equations on a real submanifold of C(n). Author (TAB)

N67-16377# Illinois Univ., Urbana. Coordinated Science Lab.
A MULTIPLE SEPARATION FUNCTION FOR PATTERN CLASSIFICATION
Kikumi Tatsuoka Aug. 1966 32 p refs
(Contract DA-28-043-AMC-00073(E))
(R-313; AD-640541) CFSTI: HC $3.00/MF $0.65

This paper develops a method for classifying any object which can be represented as a point in n-space into one of m given subsets by constructing a linear function which is derived from the support function in linear topological space, an approach hitherto unexplored in this connection. Greenberg and Konheim (1964) discussed this problem of classification scheme by presenting two possible procedures: one is to use pairwise class separation, and the other is to construct m linear functions which separate one of the sets from all the others. The former requires the construction of m(-1)/2 linear functions, and the latter places more stringent restrictions on the m subsets than the former. The author shows in this report how to construct m instead of m(m-1)/2, linear functions under the more liberal assumptions of the first procedure, thus combining the merits of both procedures. The application of his procedure to a problem in the classification of sequences of student responses on the PLATO teaching system is discussed. In that connection, a possible further development, an even simpler method requiring only one linear function, was explored. The validity of this simpler method could, however, be established only under rather restrictive conditions. Author (TAB)

N67-16432# RAND Corp., Santa Monica, Calif.
ON A BESSEL FUNCTION INTEGRAL
William Solfrey Nov. 1966 11 p refs
(Contract AF 49(638)-1700; Proj. RAND)
(RM-5189-PR; AD-642272) CFSTI: HC $3.00/MF $0.65

In the course of continuing investigations on the propagation of electromagnetic pulses, it became necessary to evaluate an integral involving exponential and Bessel functions. It was found that this integral had been evaluated incorrectly in the literature, and the error has been perpetuated for nearly 30 years. This memorandum evaluates the integral correctly, and shows that although the incorrect result had been expressed entirely in terms of algebraic and logarithmic functions, the correct result is considerably more complicated, and involves incomplete gamma functions. Author (TAB)

N67-16445# Harry Diamond Labs., Washington, D. C.
GENERATING BESSEL FUNCTIONS WITH AN ANALOG COMPUTER
Arthur Hausner Sep. 1966 30 p refs
(HDL-TM-66-14; AD-643144) CFSTI: HC $3.00/MF $0.65

Because of an indeterminate expression at the origin, Bessel functions J sub n(x) have not been amenable to an accurate generation with analog computers for $0 < x < x$ max. This report extends an idea of Van Remoortere to use an approximation for $0 < x < x$ sub 1 and solve a differential equation for x sub 1 $< x < x$ max, combining both phases by switching. The technique described uses Chebyshev polynomials to minimize equipment in the approximation phase, and generates the function $1/x$ by an integration process in the differential-equation phase to extend the range. The examples given for J sub o, J sub 1, and J sub 9 indicate excellent accuracy for at least $0 < x < 100$. TAB

N67-16462# California Univ., Berkeley. Operations Research Center.
AN ALGORITHM FOR SOLVING THE LINEAR INTEGER PROGRAMMING PROBLEM OVER A FINITE ADDITIVE GROUP, WITH EXTENSIONS TO SOLVING GENERAL LINEAR AND CERTAIN NONLINEAR INTEGER PROBLEMS
Fred Glover Sep. 1966 47 p refs
(Contract DA-31-124-ARO(D)-331)
(ORC-66-29; AROD-5307-19; AD-642276) CFSTI: HC $3.00/MF $0.65

Ralph Gomory has recently aroused interest in a special type of knapsack problem in which the constraint coefficients and constant term are elements of a finite additive group. The significance of this problem lies in the fact that it is closely related to the general integer linear programming problem, resulting by removing the nonnegativity restrictions on those variables in the general problem that lie in an optimal basis for the associated linear program. Gomory has shown how to solve the special knapsack problem by adapting a dynamic programming recursion originally designed for the ordinary knapsack problem, and has identified sufficient conditions under which the solution of the special knapsack problem will satisfy the nonnegativity requirements in the general integer program, thereby yielding an optimal solution to that problem as well. In this paper the author presents an algorithm for solving the special knapsack problem that is capable of accommodating a variety of constraints in addition to the special knapsack constraint. The purpose in doing this is to expand the range of problems for which the optimal solution for the special problem will also provide an optimal solution to the general integer program from which it was derived. Author (TAB)

N67-16466# New York Univ., N. Y. Courant Inst. of Mathematical Sciences.
BIBLIOGRAPHY OF SCHLICHT FUNCTIONS
S. D. Bernardi May 1966 169 p refs
(Contract Nonr-285(46))
(IMM-351; AD-642657) CFSTI: HC $3.00/MF $0.65

This bibliography contains 1694 references to the publications of more than 570 authors which have appeared in approximately 220 mathematical journals in the U. S. A., the Soviet Union, England, Germany, France, Japan, and in many other countries. It includes many symposiums, colloquiums, congresses, dissertations, abstracts, technical reports, lecture notes, and books dealing with the theory of analytic univalent (Schlicht) and multivalent mappings

of simply and multiply-connected domains. This survey covers the years 1907 (when the first substantial results were published) through 1965. Most of the papers listed in the bibliography have been reviewed in the Mathematical Reviews or in the Zentralblatt fur Mathematik or in the Jahrbuch uber die Fortschritte der Mathematik, and the volume and page number of the review is indicated at the end of each reference. The various results in the theory of Schlicht functions have been classified into sixty-eight subtopics. Each subtopic is followed by a list of those references in the bibliography containing information pertaining to that subtopic. Moreover, following each reference in the bibliography is a list of those subtopics which are discussed in that reference. Also given is a list of expository papers, and a list of those papers on Schlicht functions which appear in twenty-two mathematical journals that are readily available to the American public. Author (TAB)

N67-16472# Information Research Associates, Inc., Lexington, Mass.
ON SELECTING VARIABLES IN SUCCESSION FOR BEST DISCRIMINATION
Poduri S. R. S. Rao 2 Dec. 1966 18 p
(Contract Nonr-4752(00))
(IRA-100:10; TN-6; AD-643404) CFSTI: HC $3.00/MF $0.65

This note is a continuation of the work presented in technical note no. 4 (AD-638 493). In section 1 of this note an investigation is made as to whether a variable should be included in or rejected from the linear discriminator (pattern recognizer) when the requirement is that the inclusion of a variable should give a fixed percentage increase to the squared distance. (In other words, inclusion of a variable should result in decreasing the probability of misclassification by a fixed amount.) In section 2, the effect of positive and negative correlations of the variables in the discriminator is investigated. The investigation in section 2 provides insight for the acceptance or rejection of a variable for discrimination. Author (TAB)

N67-16478# Hebrew Univ., Jerusalem (Israel). Dept. of Mathematics.
ON MINIMAL SEPARATING COLLECTIONS
Bezalel Peleg Aug. 1966 10 p refs
(Contract N62558-4355)
(RM-21; AD-641460) CFSTI: HC $3.00/MF $0.65

The knowledge of minimal separating collections is important in connection with the computation of the kernel of a cooperative game. This paper determines the maximum number of sets in a minimal separating collection. Author (TAB)

N67-16586# RAND Corp., Santa Monica, Calif.
ELEMENTS OF SEQUENTIAL DECISION PROCESSES
E. V. Denardo and L. G. Mitten Oct. 1966 40 p refs
(Contract AF 49(638)-1700; Proj. RAND)
(RM-5057-PR; AD-642055) CFSTI: HC $3.00/MF $0.65

The memorandum partially elucidates and mildly extends the class of optimization problems to which the methods of dynamic programming are applicable. It contains the analysis of a simple but broad class of dynamic programming problems and a heuristic approach to a broader class of dynamic programming problems. The common elements of these problems are collected under the name sequential decision process. Since the analytic techniques used are fairly elementary, the memorandum also serves as an introduction to dynamic programming. In addition, it provides models with which an individual can determine the sometimes involved issue of whether the techniques of dynamic programming can be applied to his problem. Also included is an algorithm that can be used to analyze a broad array of sequential decision processes. Author (TAB)

N67-16591# Hawaii Univ., Honolulu. Dept. of Electrical Engineering.
SOME REMARKS ON THE VECTOR SUBSPACES OF A FINITE FIELD
R. L. Pele 20 Jun. 1966 14 p ref
(Contract AF 19(628)-4379)
(AFCRL-66-477; SR-8; AD-640886) CFSTI: HC $3.00/MF $0.65

Let F be a finite field of elements and E an extension of F of degree n. Consider E as a vector space over F. It is shown that for every subspace V of E there exists a unique polynomial whose roots are the elements of V, and there exists a unique polynomial g(X) of the same form, but of degree q(n-r), such that g(E) = V, where r is the dimension of V. Furthermore f(X) and g(X) split completely in E, and f(g(X)) = g(f(X)) = Xq(n) - X. Author (TAB)

N67-16651# Stanford Univ., Calif. Dept. of Statistics.
EMPIRICAL NONLINEAR PREDICTION AND POLYSPECTRA
John W. Van Ness 12 Sep. 1966 19 p refs
(Grants DA-ARO(D)-31-124-G726); NSF GP-4265)
(AROD-2025-18; TR-18; AD-640868) CFSTI: HC $3.00/MF $0.65

The classical linear prediction problem has received much attention both theoretically and empirically in the past few decades and a great deal is known about it (though there remain important open questions). The nonlinear prediction problem is much more difficult and much less is known about it. The present paper discusses a means of obtaining certain two-sided nonlinear predictors of a stationary process (X(t,w)) given a jointly stationary process (Y(t,w)). Author (TAB)

N67-16670*# Hughes Aircraft Co., Culver City, Calif.
PROJECT "DIODE RELIABILITY PREDICTION TECHNIQUE"
C. M. Ryerson Washington, NASA, Feb. 1967 87 p refs
(Contract NAS5-9638)
(NASA-CR-702) CFSTI: HC $3.00/MF $0.65 CSCL 14D

This project has succeeded in its objective of developing a new approach to reliability prediction for semiconductor diodes based on realistic mathematical models. A new rationale for reliability modeling was developed by defining reasonable approximations and expressing in useable mathematical form the natural processes of degradation to failure under stress. A law of failure rate prediction was thus established for diodes. Some of the uses of this law can be summarized as follows: (1) to determine if a lot of parts is typical of the standard part; (2) to establish a new model for similar but different types; (3) to evaluate the differences between supposedly identical lots; (4) to compare products from different suppliers; (5) to evaluate consistency of quality control in a supplier's plant from lot to lot; (6) to compare the effectiveness of quality control between suppliers for the same type parts; (7) to establish new constants and models for different part types; and (8) to purify and perfect the model to deeper levels of interaction simulation. Author

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N67-15411# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
JOINT RADAR AND AEROLOGICAL OBSERVATIONS IN THE LOWER 1.5-KM LAYER OF THE ATMOSPHERE

B. B. Brylev, I. V. Vasil'chenko, V. I. Selitskaya, and A. A. Federov 18 Aug. 1966 24 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Moscow), no. 173, 1965 p 76–87
(Contract NOw-62-0604-c)
(TG-230-496; TT-66-61159; AD-640610) CFSTI: HC $3.00/MF $0.65

The results of joint radar and aerological observations in the lower 1.5-km layer of the atmosphere are examined. A connection between clearsky radar returns and convective and turbulent motion in the atmosphere is demonstrated. Author (TAB)

N67-15422*# Israel Program for Scientific Translations, Ltd., Jerusalem.
PHYSICAL METEOROLOGY
A. Kh. Khrgian *In its* Achievements of Sci.: Geophys., 1962 1966 p 1–21 refs (See N67-15421 06-13) CFSTI: HC $3.00/MF $0.65

The use of satellites, rockets, improved radar methods, and balloon sondes for observation of such elements as ozone and chemical admixtures in the atmosphere is considered. Advances in the physics of clouds and the investigation of radiation balance are also reviewed. Use of satellites for determining the temperature of the earth, of the lower layers of the atmosphere, and of the upper surface of clouds is discussed. Parallel with observations from satellites is the use of infrared radiation data obtained from ground observation. The problem of the connection between the ozone content and vertical motions in the atmosphere is examined. Various observations on radiolocation of clouds and precipitation are enumerated. Attention is given to radio reflections from cloudless atmosphere called "thermics" and caused either by atmospheric turbulence or by convection. The physics of clouds is presented with discussions on cirrus and orographic clouds, electricity of clouds, and artificial modifications of clouds. S.P.

N67-15423*# Israel Program for Scientific Translations, Ltd., Jerusalem.
DYNAMIC AND SYNOPTIC METEOROLOGY
A. S. Monin *In its* Achievements of Sci.: Geophys., 1962 1966 p 22–38 refs (See N67-15421 06-13) CFSTI: HC $3.00/MF $0.65

Weather forcasting, large-scale atmospheric processes, and general circulation of the atmosphere are considered in discussions of dynamic and synoptic meteorology. Such topics as the role of thermal effects in the formation of atmospheric processes and the analysis of multiannual variations in circulation are discussed. The use of artificial satellites for meteorological observations of synoptical processes is mentioned. Means of studying stratospheric processes are related, and models of the meridional circulation in the stratosphere and mesosphere are discussed. Finally methods for studying atmospheric turbulence and diffusion are described. S.P.

N67-15424*# Israel Program for Scientific Translations, Ltd., Jerusalem.
CLIMATOLOGY
S. P. Kromov *In its* Achievements of Sci.: Geophys., 1962 1966 p 39–59 refs (See N67-15421 06-13) CFSTI: HC $3.00/MF $0.65

A review of various works dealing with climatology is presented. Individual climatic elements such as precipitation are discussed. Regional publications in the form of atlases, diagrams, and tables of climatic norms are listed. Publications dealing with classification of climates and climatic regioning are summarized. Radiation heat balance of the terrestrial surface is considered as a factor of climate formation together with the general circulation of the atmosphere. Information on the climatologic wind regime including local winds, and wind in the tropical stratosphere is presented. Other topics examined are jet streams, monsoons, tropical cyclones, cyclonic activity in extratropical latitudes, tornadoes, air masses and fronts, aeroclimatology, moisture circulation, the temperature regime, and geological climate variations. S.P.

N67-15469*# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE EFFECT OF SYNOPTIC FRONTS ON SEEING
N. I. Kucherov *In its* Opt. Instability of the Earth's Atmosphere 1966 p 50–58 refs (See N67-15461 06-13) CFSTI: HC $3.00/MF $0.65

Optical instabilities in the atmosphere were described in terms of shimmer angle and mean square amplitude of image pulsation reduced to zenith. Graphs of nightly averages of these properties plotted over a certain length of time were the basic characteristics of local astroclimates. Analysis of graphs collected from various regions of the U.S.S.R. during the years 1960 to 1962 led to the following conclusions: deteriorated a long time before the actual passage of a synoptic front due to orographic disturbances of the air stream. Processes responsible for the seeing deterioration of seeing are analogous to those that cause bumpy air plane flights; in both cases form eddy processes with density variations. The intensity of cold-front turbulent mixing was attributed to stream convergence, rising temperature gradients, and the "collapse" of cold air due to frictional deceleration, on account of which the bottom layers of cold air lag behind the summit masses as the front advances. Downward eddy motions were less pronounced in warm fronts. G.G.

N67-15482# Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology.
WIND TUNNEL MEASUREMENTS OF THE WIND DISTURBANCE FIELD OF A MODEL OF THE BUZZARDS BAY ENTRANCE LIGHT TOWER
E. L. Mollo-Christensen and J. R. Seesholtz Sep. 1966 19 p
(Contract N140(122)77626B)
(AD-640628) CFSTI: HC $3.00/MF $0.65

Wind tunnel model tests were carried out to measure the wind interference created by the Buzzards Bay Entrance Light Tower in the atmospheric boundary layer. Tunnel measurements of wind profile were carried out at certain positions in the vicinity of the tower for several wind directions. The results indicate that at a distance of 50 feet from the tower the wind velocity profile may change about six percent, and larger changes are observed in certain special cases. Author (TAB)

N67-15773# Miami Univ., Fla. Inst. of Marine Science.
CHARACTERISTICS OF THE HURRICANE SEASON IN THE NORTH ATLANTIC OCEAN INCLUDING THE CARIBBEAN SEA AND THE GULF OF MEXICO Final Report
Jose Carlos Millas Apr. 1966 73 p refs
(Contract Cwb-11179)
(ML-66135; Rept.-8868-1)

Results are presented of an investigation made of the origins, trends, extent, and periodicity of the hurricane and tropical storm season in the North Atlantic Ocean based on reliable data gathered from 1885 to 1964. The study shows that most hurricane seasons begin in either June or August. Early season storms mostly originate in the Gulf of Mexico and Western Caribbean. None of the 637 hurricanes and tropical storms studied originated east of a line from the center of Hispaniola to Southern Panama. The peak hurricane season is August, September, and October with a marked increase in the latter half of August, the highest level of activity in the first half of September, and a marked decrease in the last half of October. The average season for the 80-year period studied had 8 cyclones. The seasons from 1885 to 1930 were generally of low activity as compared to those from 1931 to 1964. Hurricane seasons are sometimes interrupted by nonactive periods followed by active periods. Seasons which ended as late as December started early, while seasons that started late usually terminated in October. R.N.A.

N67-16220 National Environmental Satellite Center, Suitland, Md.

MESOSCALE CELLULAR CONVECTION

Lester F. Hubert May 1966 76 p refs

(Rept.-37; PB-170814) CFSTI: HC $3.00/MF $0.65

The large areal extent of mesoscale cellular patterns is cumuli suggests there exists a scale of mesoscale convection that is significant to air–sea exchange mechanisms. The purpose here is to bring together a representative sample of satellite and associated meteorological data concerning these cells, and to propose a hypothesis for them that is based on the extent work on Benard convection. As in the laboratory two classes of cells appear to exist: those with ascent in the cell centers and those with descent in the cell centers. Experiment and theory indicate this may be due to the vertical variation of eddy viscosity. It is suggested that the destabilizing effect of surface heating and cloud top cooling by radiation determine this vertical variation, and that these usually are of greater magnitude than evaporation cooling or release of latent heat. Shear and non-steady-state heating are unfavorable for these mesoscale cells, but rotation probably has no effect. Suggestions for future work are to construct a theoretical model that incorporates anisotropic, variable, eddy exchanges and diabatic energy sources other than latent instability. Suggested experimental work should be carried out in the atmosphere, not in the laboratory, and it should include measurements of eddy flux of heat and momentum as well as the diabatic energy sources. Author (R&DR)

N67-16405# Emmanuel Coll., Boston, Mass. Oriental Science Library.

A THREE-LEVEL NONLINEAR PREDICTION MODEL IN SPHERICAL COORDINATES

Yung-T'i Chu Bedford, Mass., AFCRL, May 1966 32 p refs Transl. into ENGLISH from Ch'i Hsiang Hsueh Pao (Peking), v. 31, no. 3, 1961 p 218–233

(Contract AF 19(628)-5073)

(EMM-66-64; AD-642402) CFSTI: HC $3.00/MF $0.65

This paper applies theoretical results of works by Blinova and Chu Yung-ti to formulate a three-level nonlinear prediction model in spherical coordinates to assess the effect of topography on the prediction of the isobaric field, the working levels being 1000, 500 and 300 mb. The auxiliary function L of the perturbation source function is computed from the contour fields at 1000, 700, 500, 300 and 100 mb by means of a system of localized rectangular coordinates. When $t > 0$, the L-field and the contour field are predicted in parallel by a Eulerian method. An interpolation formula for the evaluation of the influence function (Greens function) and an approximation of the function in the neighborhood of a singular point are suggested. The proposed model has been programmed for computation on the large high-speed electronic computer (BESM-1) of the USSR Academy of Sciences and the numerical output analyzed. The results show that the proposed model is suitable for the hemispherical prognoses of the flow pattern as well as the surface pressure field for more than 24 hours. Author (TAB)

N67-16440# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.

WIND AND TEMPERATURE DATA FOR THE FIRST 62 METERS OF THE BOUNDARY LAYER AT WHITE SANDS MISSILE RANGE Data Report

Frank V. Hansen Sep. 1966 47 p refs

(ECOM-5079; AD-641579) CFSTI: HC $3.00/MF $0.65

Twenty-minute wind and temperature profiles observed in the first 62 meters of the boundary layer at White Sands Missile Range are presented. The 147 profiles were selected because these research quality data are considered representative of conditions over an extremely rough nonhomogeneous surface in a semi-arid region. Author (TAB)

N67-16490# New York Univ., N. Y. Research Div.

A THEORY OF TURBULENT EDDIES

A. D. Kirwan, Jr. Jan. 1966 52 p refs

(Grant NSF GU-894)

(TR-66-3; PB-169465) CFSTI: HC $3.00/MF $0.65

Turbulent phenomena of inviscid fluids are treated from a rather novel point of view. The basic turbulence statistic is taken as a turbulent displacement vector, the rms value of which might be regarded as an average eddy size. It is postulated that the displacement vector is related to the turbulent velocity through a second order tensor which is a function of the mean characteristics of the flow. This procedure has several advantages in studying shear induced turbulence. Firstly, it distinguishes between turbulence induced purely by the mean vorticity and that associated with mean deformation. Secondly, it leads to a concise geometrical interpretation of Reynolds stress. This in turn leads to a distinction between two types of turbulent kinetic energies; one associated with the mean deformation of turbulent eddies, and one associated with the mean vorticity as exemplified by the average rotation of the eddies. The approach taken here also leads quite naturally to two new sets of equations pertinent to turbulence. Author (TAB)

N67-16588# Allied Research Associates, Inc., Concord, Mass.

SATELLITE OBSERVED CLOUD COVER IN SOUTHEAST ASIA First Interim Report, 15 May–25 Oct. 1966

Donald W. Beran and Earl S. Marritt Ft. Monmouth, N. J., Army Electron. Command, Dec. 1966 64 p refs

(Contract DA-28-043-AMC-02308)

(Rept.-9G32-1; ECOM-02308-1; AD-643269) CFSTI: HC $3.00/MF $0.65

The purpose of the study is to develop techniques to assist the Army in mesoscale analysis and prediction, for both air and ground operations in Vietnam, through the application of satellite observations. The report describes the work leading up to the selection of a reliable sample of satellite pictures for use in latter study phases. A review of pertinent literature, concerning the climate and topography of Vietnam is followed by a description of the method used to extract useable data from satellite pictures. Satellite data extraction procedures were developed in a manner which leads to information compatible with conventional observations. When the satellite-observed cloud information was compared with conventional data, the representatives of the sample could be established. The effect of terrain on cloud production is shown by the different cloud distribution over homogeneous regions of Southeast Asia. The lack of a 'U' shaped cloud distribution, commonly found in the mid-latitudes, is also indicative of the strong terrain influence. Author (TAB)

N67-16623* National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

PERCENTAGE LEVELS OF WIND SPEED DIFFERENCES COMPUTED BY USING RAWINSONDE WIND PROFILE DATA FROM SANTA MONICA, CALIFORNIA

Dennis W. Camp and Patricia A. Fox 21 Oct. 1966 374 p refs

(NASA-TM-X-53528) CFSTI: HC $3.00 CSCL 04B

Presented are percentage levels of wind speed differences computed from AN/GMD-1 wind profile data obtained at Long Beach and Santa Monica, California. Compiled in 13,152 profiles are nine years of rawinsonde wind profile data: January 1, 1956, through December 31, 1964. The results are based on each kilometer of wind velocity data for the 1.0 through 25.0 km altitude interval. These results may be used as an aid in predicting statistical limits of upper level winds and to provide an understanding of the statistical probabilities of wind speed change as a function of time. The information is also of use in space vehicle launch and related operations. Author

N67-16681*# Kaman Aircraft Corp., Colorado Springs, Colo. Nuclear Div.
VARIABILITY OF SOUND PROPAGATION PREDICTION DUE TO ATMOSPHERIC VARIABILITY Final Report
C. Eugene Buell 10 Jun. 1966 184 p refs
(Contract NAS8-11348)
(NASA-CR-61160) CFSTI: HC $3.00/MF $0.65 CSCL 04B

The effect of variable meteorological parameters on the estimates of sound intensity at distances from a few to several tens of kilometers is discussed. Meteorological parameters concerned are virtual temperature, wind components, and humidity (water vapor pressure specifically). Sound intensity estimates are based on results of a ray tracing technique. The variations of intensity estimates as determined by Monte Carlo methods are described. It is found that the variability is near 5 decibels regardless of whether the magnitude of atmospheric variability corresponds to that expected over a fraction of an hour or a half a day. The effect of atmospheric variability on sound attenuation is of a different character from that due to the effect on the geometry of the propagative pattern and may be determined by standard methods. Results indicate that the variability of atmospheric humidity is the most important factor. The small scale perturbations have little effect, but large scale perturbations that enter into variations expected over a period of half a day may account for intensity variability of several (near 5) decibels at 10 km. S.P.

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N67-15783*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
STRAPDOWN ELECTRICALLY SUSPENDED GYRO DEVELOPMENT
T. J. Donlin *In its* Space Programs Sum. No. 37-40, Vol. 4 31 Aug. 1966 p 15-16 (See N67-15781 06-34) CFSTI: HC $3.00/MF $0.65

Summary information is presented on the results of compatibility tests conducted between the electrically suspended gyro (ESG) rotor-housing assembly, the suspension electronics, the readout electronics, and the control console. Also reported is the use of three different frequencies, one on each axis, to detect rotor to electrode capacitance, and to eliminate any interaction between axes and any interaction with the forcing voltage frequency. It is pointed out that this means of detecting rotor position allows greater stability of the rotor position with regard to changes in dimension, temperature, and rotor electrical charge. M.G.J.

N67-15961# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
AN ELECTROMECHANICAL ANALOG FOR AUTOPILOT-AEROELASTIC MISSILE STUDIES
J. P. Kearns and B. M. Reid Jun. 1966 60 p
(Contract NOw-62-0604-c)
(TG-820; AD-642616) CFSTI: HC $3.00/MF $0.65

An electromechanical analog of an autopilot and elastic missile in the pitch plane was developed. A purely electrical analog is employed in the conventional manner to simulate the autopilot and the rigid body in pitch. To this analog is connected, via an appropriate crossover network, a mechanical analog, a physical beam driven by shakers which represents the aeroelastic missile. The real-rate gyro mounted on the beam produces a signal to be fed back into the autopilot. A stability analysis of this system was performed for two basic cases. Reasonable agreement between theoretical and experimental gain margins was found. This concept of an analog combination, much like the woofer-tweeter type used in high fidelity systems, should be useful in future studies of missile autopilot-aeroelastic instabilities. Author (TAB)

N67-16059*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE TECHNOLOGY. VOLUME IV: SPACECRAFT GUIDANCE AND CONTROL
J. R. Scull Washington, NASA, 1966 140 p refs
(Grant NsG-598)
(NASA-SP-68) GPO: HC $0.55; CFSTI: MF $0.65 CSCL 17G

The primary purpose of this book is to discuss the guidance of lunar and planetary spacecraft with less-than-usual emphasis on satellites. The discussion will cover the tradeoffs among injection, midcourse, and terminal guidance as well as ways of mechanizing these systems by radio, inertial, or celestial techniques. Examples of these guidance systems as applied to some of the current lunar and planetary spacecraft will be described. Spacecraft guidance is in many respects quite similar to guidance of a plane or ship with one major exception; guiding a typical spacecraft is similar to getting all of the speed needed for a transoceanic flight at the beginning of the flight, aiming in the direction of the target, and shutting off the engines with the control surfaces locked and coasting with zero drag to the target. The only exception to this type of approach is that used for electric-propulsion vehicles of very low thrust. Author

N67-16127# Lockheed-Georgia Co., Marietta.
DEVELOPMENT OF ALL WEATHER LANDING SYSTEM RELIABILITY ANALYSIS AND CRITERIA FOR CATEGORY III GROUND SYSTEMS
L. A. Adkins, M. C. Thatro, and L. D. Schiller Aug. 1966 241 p refs
(Contract FA-65-WA-1376)
(ER-8541, Vol. II; RD-66-43, II; AD-640605) CFSTI: HC $3.00/MF $0.65

The report presents the results of a five-month study program on the proposed Category III ILS ground system. The primary program effort was directed to the evaluation and adequacy of Reliability, Availability, Safety, Cost Effectiveness, Redundancy and Monitoring. Included in the report is the format and summary of several computer programs utilizing a basic reliability model of the complete ground system. From these programs data was generated to depict the effect of various levels of redundancy and component reliability on system reliability and availability. Data is also presented to depict the combined effect of Mean-Time-Between-Failure and Mean-Time-to-Restore on availability and the resulting impact on maintenance requirements. The potential cost increments incurred from loss of Availability as a result of various levels of unreliability in terms of maintenance and user loss is presented for several levels of ILS weather conditions. A proposed program is included for the inclusion of guaranteed reliability requirements in the procurement of ILS ground system components. Author (TAB)

N67-16656# White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.
A SOUND-RANGING TECHNIQUE FOR LOCATING SUPERSONIC MISSILES
Henry Rachele May 1966 29 p refs
(ECOM-5055; AD-641669) CFSTI: HC $3.00/MF $0.65

Mathematical formulations are developed which can be used with conventional sound-ranging data for determining a first approximation of a point on a trajectory of a vertically falling supersonic missile. The most interesting feature of the development is that it requires only a single four-microphone square array. Author (TAB)

N67-16667* Control Data Corp., Minneapolis, Minn.
A THEORETICAL INVESTIGATION OF INFORMATION LIMITS OF SCANNING OPTICAL SYSTEMS
Edward J. Farrell, C. Duane Zimmerman, Donald F. Nickel, and Richard C. Borden Washington, NASA, Jan. 1967 433 p refs
(Contract NAS1-4646)
(NASA-CR-672) CFSTI: HC $3.00/MF $0.65 CSCL 17G

Basic system parameters of a three axis attitude sensor system for use in optical scanning of the sky are outlined, and the information limits of optical scanning systems are discussed. Mathematical models of the amount and distribution of energy received by such systems from star radiation and stellar background radiation, are presented. The information content of photoelectric star images are examined. The characteristics and suitability of a number of photodetectors used for space navigational systems are discussed. Signal processing techniques are developed using the described radiation models under several operating situations, to develop an efficient processing technique for each situation. Multiple observation techniques are briefly described. The importance of the complete models and the efficient processing techniques lies in the effect they have on the gross system characteristics (size, weight, power, reliability, and cost) and the system performance characteristics (attitude accuracy, probability of star pattern recognition). An automated design program was prepared for a digital computer to verify the design logic. L.S.

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N67-15460 Atomic Energy Establishment, Winfrith (England). Technical Assessments and Services Div.

CUSH—A COMPUTER PROGRAMME FOR THE STEADY STATE HYDRAULIC ANALYSIS OF STEAM GENERATING REACTOR SYSTEMS

W. R. Cushing and M. C. Ingram 1966 54 p ref
(AEEW-M-474) HMSO: 7s

The CUSH program is written in FORTRAN and versions exist for the IBM 7090, IBM 7030 and EEC KDF-9 computers. The program requires a three-dimensional specification of the core power distribution and calculates the distribution of flow and coolant density within the core and primary circuit. Author

N67-15525# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.

LARGE SCALE PRODUCTION AND APPLICATIONS OF RADIOISOTOPES

May 1966 301 p refs Proc. of the Am. Nucl. Soc. Natl. Topical Meeting, Augusta, Ga., 21–23 Mar. 1966
(Contract AT(07-2)-1)
(DP-1066, Vol. 1; CONF-660305, Vol. 1) CFSTI: HC $3.00/MF $0.65

Papers on large scale radioisotope production, chemical processing, radiation and power applications, and international programs are presented. For individual titles see N67-15526–N67-15549.

N67-15526# Atomic Energy Commission, Washington, D. C. Div. of Isotopes Development.

ATOMIC ENERGY COMMISSION'S ROLE IN THE PROCESS RADIATION INDUSTRY

E. E. Fowler *In* Du Pont Large Scale Production and Appl. of Radioisotopes May 1966 5 p (See N67-15525 06-22) CFSTI: HC $3.00/MF $0.65

The three missions of the Atomic Energy Commission's Process Radiation Development Program are cited: basic radiation technology development, radiation process engineering for radiation source and facility design, and applied cooperative industry-AEC projects. Process radiation is defined as the production or processing of chemicals and materials using ionizing radiation as a source of energy to produce chemical, physical, or biological change. Some cooperative projects mentioned are designed to: demonstrate the practical feasibility of employing isotopes and radiation technology, and provide markets for radioisotopes and electron accelerators. R.L.I.

N67-15527# Argonne National Lab., Ill.

LONG RANGE SPECULATIONS ON ISOTOPIC POWER

B. I. Spinrad *In* Du Pont Large Scale Production and Appl. of Radioisotopes May 1966 10 p ref (See N67-15525 06-22) CFSTI: HC $3.00/MF $0.65

Some capabilities and technical characteristics of radioisotopic power sources are cited in this conference paper. A brief comparison with chemical sources, useful fission products, and isotope potential as reactor fuel are other points mentioned. Matching isotopes to mission objectives and shielding of radioisotope sources are also sketched. Some applications of radioisotope technology are included for: space probes, far-out solar system station power supply, isotopes powering sonar ocean beacons, exploitation of submarine shipping lanes, and poodle systems staged for shorter space missions. R.L.I.

N67-15528# Atomic Energy Commission, Washington, D. C.

PLUTONIUM AND OTHER RADIOISOTOPE SOURCES—DISCOVERY TO DEMAND

G. F. Tape *In* Du Pont Large Scale Production and Appl. of Radioisotopes May 1966 11 p (See N67-15525 06-22) CFSTI: HC $3.00/MF $0.65

Propitious utilization of plutonium power sources is briefly discussed. The identification of plutonium 238, the exploration of transuranium elements, and the discovery of a readily fissionable isotope of plutonium are reported. Power reactor sources producing neptunium 237, intense neutron irradiation in very high flux reactors, heavy ion bombardment in special purpose accelerators, and instantaneous neutron irradiation in a nuclear explosion are other tasks sketched. Application technology for national security, as well as for educational and economic benefits are summarized for: the development of nuclear propulsion for submarines, economical power reactors, medical utilization of radioisotopes, reactor fission products as power source, and isotope weapons mission. R.L.I.

N67-15529# Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.

PRODUCTION OF RADIOISOTOPES IN PRODUCTION REACTORS

W. P. Overbeck *In its* Large Scale Production and Appl. of Radioisotopes May 1966 25 p refs (See N67-15525 06-22) CFSTI: HC $3.00/MF $0.65

The urgent and substantial need for reactor-produced radioisotopes, production reactor capacity, and production economy and capability are concisely examined. General considerations affecting the selection of fission products are also traced. Production programs are summarized for: cobalt-60, the only isotope for which large-scale production is possible; plutonium 238, the first radioisotope used as an aerospace power source; curium 244, produced by long-term irradiation of plutonium 239; and, polonium 210, used as a power source to demonstrate the low-thrust POODLE rocket engine. R.L.I.

N67-15530# Oak Ridge National Lab., Tenn.

PRODUCTION OF RADIOISOTOPES IN POWER REACTORS

A. F. Rupp *In* Du Pont Large Scale Production and Appl. of Radioisotopes May 1966 24 p refs (See N67-15525 06-22) CFSTI: HC $3.00/MF $0.65

Optimizing the parameters in the power reactor production of Pu-238 and Cm-244 radioisotopes is considered in relation to irradiation, scientific, and medical applications. Several criteria that radioisotopes for power reactor production should meet, the economics of fuel recycle, the use of high flux converter reactors, and special reactor and target loadings to give a more favorable neutron spectrum are reviewed and much ancillary technical data presented. Concluding remarks indicate that the projected demand for all isotopic power fuels appears to go beyond anticipated production, especially for Pu-238, and that careful recycling of power reactor fuels and integrated management of U-236, Np-237, Pu-238, Pu-241, Am-241–243, and Cm-244 will be necessary to optimize isotopic power fuels production and ensure profits. R.Ll.

N67-15531# General Electric Co., Pleasanton, Calif. Irradiation Processing Operation.

PRODUCTION OF RADIOISOTOPES IN COMMERCIAL REACTORS

T. J. Slosek *In* Du Pont Large Scale Production and Appl. of Radioisotopes May 1966 17 p refs (See N67-15525 06-22) CFSTI: HC $3.00/MF $0.65

The potential benefits from the application of radioisotopes in medicine, in industry, and in various fields of research and development are briefly outlined in the evolution of the commercial radioisotope industry. Large-scale production of radioisotope labelled chemicals, radiopharmaceuticals manufacture, encapsulation of cobalt-60 and its industrial radiography application, together with market and distribution history are also evaluated. Private-reactor-produced Thulium-170, used to power an experimental thermionic converter, as well as Plutonium-238 isotope-powered alpha emitters are also briefly mentioned. R.Ll.

N67-15532# Union Carbide Corp., Oak Ridge, Tenn. Isotopes Development Center.

LARGE SCALE PROCESSING AND SOURCE PREPARATION OF NEUTRON-PRODUCED ISOTOPES

E. Lamb *In* Du Pont Large Scale Production and Appl. of Radioisotopes May 1966 12 p refs (See N67-15525 06-22) CFSTI: HC $3.00/MF $0.65

Large-scale processing of neutron-produced radioisotopes for commercial and isotopic power applications are analyzed. Source preparation, including data on preparation of target materials, reactor irradiation, recovery and purification of the product radioisotope, and conversion to the required product form, is detailed. Depicted is the complicated scheme for production of ^{242}Cm from ^{241}Am in which substantial quantities of fission products are also produced. Neutron reactions with other isotopes in the target element, e.g., ^{171}Tm from natural erbium, are also shown graphically. Curium-242 and curium-244 processing done at the recovery facility, in addition to Thulium-171 and Curium-244 process development, are also detailed. R.Ll.

N67-15535# Atomic Energy of Canada, Ltd., Ottawa (Ontario).

THE CANADIAN PROGRAM ON LARGE SCALE PRODUCTION AND APPLICATION OF RADIOISOTOPES

R. F. Errington *In* Du Pont Large Scale Production and Appl. of Radioisotopes May 1966 28 p refs (See N67-15525 06-22) CFSTI: HC $3.00/MF $0.65

The Canadian program of production, distribution and use of radioisotopes such as 60Co is presented. Commercial applications in isotopic food preservation, and the impact in the fields of agriculture, fisheries, food processing, packaging, refrigeration and storage facilities, transportation, marketing, and world trade are assessed. Cobalt-60 sterilization of medical products, and Cobalt-60 water-pool-powered irradiation plants are also reported. Engineering and design considerations are also included on medical equipment sterilizing irradiators. R.Ll.

N67-15536# United Kingdom Atomic Energy Authority, Amersham (England).

THE LARGE SCALE PRODUCTION AND UTILIZATION OF RADIOISOTOPES IN THE UNITED KINGDOM

H. Sheard *In* Du Pont Large Scale Production and Appl. of Radioisotopes May 1966 11 p refs (See N67-15525 06-22) CFSTI: HC $3.00/MF $0.65

The large scale production and utilization of radioisotopes in the United Kingdom has up to the present been confined in practice to cobalt-60. Industrial sterilization with gamma radiation from cobalt-60 has become an established commercial process. Five large plants are operating in the United Kingdom, with a total source strength of about 800,000 curies. The products treated are principally medical supplies, with disposable hypodermic syringes and surgical sutures constituting numerically by far the largest classes. Over the last six years it is estimated than more than 160 million syringes, and 40 million sutures, have been sterilized by radiation. The combined value of all the products at present being treated in irradiation plants in the United Kingdom is about $45,000,000 per year. Food preservation and chemical processing by ionizing radiation have been extensively studied but are not established as viable commercial operations. Author

N67-15537# Commissariat a l'Energie Atomique, Saclay (France). Isotopes Div.

PRODUCTION AND UTILIZATION OF RADIOISOTOPES IN CONTINENTAL EUROPE

C. Fisher *In* Du Pont Large Scale Production and Appl. of Radioisotopes May 1966 6 p (See N67-15525 06-22) CFSTI: HC $3.00/MF $0.65

The present status of radioisotope production in Europe is summarized. While all European countries are engaged in production, most are limited to short lived isotopes. France, Belgium, and Italy, leading producers, have pooled their efforts in the common production and distribution of isotopes. SORIN (Italy), with its 5-MW swimming-pool reactor, specializes in short-lived isotopes and the preparation of radiopharmaceuticals. CEN (France) makes some sealed sources and organic labelled compounds and jointly uses the high flux reactor BR-2 with Euratom. Details are also provided on: power-reactor production of Cobalt-60, the separation of fission products, isotopic power generators, radiation processing of materials, and sterilization for food preservation. Technical data on the French-operated mobile cesium-137 irradiator (IRMA) are included. R.Ll.

N67-15539# International Atomic Energy Agency, Vienna (Austria). Dept. of Research and Isotopes.

INTERNATIONAL PROGRAMS OF THE INTERNATIONAL ATOMIC ENERGY AGENCY

H. Seligman *In* Du Pont Large Scale Production and Appl. of Radioisotopes May 1966 4 p (See N67-15525 06-22) CFSTI: HC $3.00/MF $0.65

Isotope application to hydrological problems, and the assessment of tritium in world rain water are two programs conducted by the International Atomic Energy Agency. Activity is recapitulated in the field of grain and food desinfestation by irradiation, big radiation sources for therapeutic applications, collecting of physical data for use in radiotherapy, radioisotope techniques to improve rice fertilization, sterile male technique application in entomology, radiobiological sterilization of pharmaceuticals and medical supplies, use of isotopes in protein malnutrition, research efforts in reactor physics and in solid state physics using neutron diffraction methods. Standardization of methods like the analysis of trace amounts in foods or agricultural products is also listed. R.Ll.

N67-15540# Laboratoires du Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).

PRODUCTION AND APPLICATION OF ACTINIUM-227 FOR DIRECT CONVERSION SOURCES

A. De Troyer (Union Miniere du Haut-Katanga) and P. Dejonghe *In* Du Pont Large Scale Production and Appl. of Radioisotopes May 1966 7 p refs (See N67-15525 06-22) CFSTI: HC $3.00/MF $0.65

The Belgian program for large-scale production of radioisotopes for direct conversion purposes is primarily concerned with the production of Ac^{227} by irradiation of Ra^{226}, and the subsequent use of Ac^{227} as an energy source for aerospace applications. Theoretical and experimental studies, and a detailed program description are reported. Prototype production, homogeneous precipitation, and ion exchange purification of actinium are delineated. It is considered that a cost per thermal watt in the same order as that of ^{238}Pu and ^{244}Cm, ^{227}Ac should rank first because of its advantages of higher power density and lower weight per electrical watt. The yearly production capability gives actinium-227 a foremost place among the most promising alpha emitting isotopes for possible European space applications. R.Ll.

N67-15542# Dow Chemical Co., Midland, Mich. Radiation Chemistry Section.

LARGE SCALE APPLICATIONS OF RADIATION FOR NEW MATERIALS

D. E. Harmer *In* Du Pont Large Scale Production and Appl. of Radioisotopes May 1966 6 p refs (See N67-15525 06-22) CFSTI: HC $3.00/MF $0.65

The application of large-scale sources of radiation, and technological developments in the field of process radiation chemistry are highlighted. The use of radiation as a processing tool in the field of polymers facilitated the manufacture of irradiated polyethylene tapes using accelerated electrons, in addition to polyethylene wire insulation, circuit boards, and shrinkable tubing. Radiation processes on materials reviewed include: wood–plastic materials made by the polymerization of various vinyl compounds in the presence of wood, monomers polymerized in the presence of wood, new material produced by radiation graft copolymerization, the reaction under radiation between styrene monomer and polyvinyl chloride, and the availability of a graft copolymer of polyethylene and acrylic acid. Radiation sources briefly delineated are: high-energy cobalt-60 radioisotope, electron accelerators, and high-energy beta-radiation. R.Ll.

N67-15543# Ethicon, Inc., Somerville, N. J.

LARGE SCALE APPLICATION OF RADIOISOTOPES TO STERILIZATION

C. Artandi *In* Du Pont Large Scale Production and Appl. of Radioisotopes May 1966 8 p refs (See N67-15525 06-22) CFSTI: HC $3.00/MF $0.65

Suitability, and cost factors of the large-scale use of radioisotopes for medical product sterilization are briefly analyzed. Electron accelerators of radiation at higher energy levels (6–12 MeV) are cited; cobalt-60 and cesium-137 are listed as candidate isotopes for gamma emitters. The selection of radiation plant design is evaluated in relation to the type of operation, efficiency, and reliability. A comparison of commercial cobalt-60 sterilization plants listing source storage, design capacity, and present load is shown graphically. Included is a pertinent bibliography. R.Ll.

N67-15546# Atomic Energy Commission, Washington, D. C. Isotope Power Systems Branch.

U. S. ATOMIC ENERGY COMMISSION ISOTOPIC POWER APPLICATIONS

R. T. Carpenter *In* Du Pont Large Scale Production and Appl. of Radioisotopes May 1966 12 p (See N67-15525 06-22) CFSTI: HC $3.00/MF $0.65

The fuel production and utilization of large-scale radioisotope applications for power generation are cited in relation to the Atomic Energy Commission's power program. Isotopic power systems development highlights: the SNAP space, terrestrial and marine systems which are electricity-producing power systems, radioisotope thrusters for space vehicle propulsion and attitude control, and a variety of purely thermal applications of isotopes. Photographs and graphical representations complete analytical data; tables delineate first and second generation SNAP isotope power systems. R.Ll.

N67-15547# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

PROJECTED LARGE SCALE USE OF RADIOISOTOPES BY NASA

R. E. English *In* Du Pont Large Scale Production and Appl. of Radioisotopes May 1966 9 p (See N67-11525 06-22) CFSTI: HC $3.00/MF $0.65

To investigate problems connected with the design of large, isotope heat sources, the particular thermal power of 50 kW was selected. In general, the analysis is relevant for thermal powers ranging from 10 to 100 kW. NASA demand for isotopes on proposed missions, and the extent of their use are conjectured and are considered to depend on the merits of isotope power systems in relation to the merits of competitive power systems. The problem of hazard associated with the isotopes themselves is attacked from the safety viewpoint and provides the basis for comparative evaluation of several isotopes. Radioisotope application is summarized under the aspects of: reentry burnup, helium containment, passive heat rejection, heat sinks, unshielded dose rates, and shield weights. R.Ll.

N67-15548# Sandia Corp., Albuquerque, N. Mex. Aerospace Nuclear Safety Dept.

AEROSPACE NUCLEAR SAFETY

V. E. Blake, Jr. *In* Du Pont Large Scale Production and Appl. of Radioisotopes May 1966 6 p refs (See N67-11525 06-22) CFSTI: HC $3.00/MF $0.65

Radiation shielding against hazards associated with the use of radioactive materials as an energy source is surveyed. A simplified version of the overall aerospace nuclear safety problem is presented in the form of a multiple path array. The eventuality of resulting radiation exposure is evaluated according to the number of people involved, the probability of exposure, and the severity of exposure. This chart is used to illustrate a systematic method of analysis covering all possible consequences of a space flight, and there are 27 different paths through this array of blocks which must be considered and for which a safety index should be evaluated. Another graphical presentation depicts a form of a safety index guide for the most severe possible exposure from a naturally occurring hazard—deaths from meteorites. It is considered that the analytical data presented could form a basis for safety design as well as evaluation. R.Ll.

N67-15549# Atomic Energy Commission, Washington, D. C. Div. of Materials Licensing.

SAFETY OF ISOTOPIC POWER SOURCES FOR TERRESTRIAL APPLICATIONS

A. Aikens, Jr. *In* DuPont Large Scale Production and Appl. of Radioisotopes May 1966 7 p (See N67-11525 06-22) CFSTI: HC $3.00/MF $0.65

Some design, and operational, characteristics are surveyed for safety devices analyzed in a radiological safety evaluation of isotopic power sources for terrestrial applications. Potential hazards of some of the radionuclides used as heat sources are briefly examined. It is stated that from the safety viewpoint, the least hazardous type and form of radioactive heat source consistent with

the design and use requirements of the device should be used. It is considered that the requirements for transport of such devices should be taken into consideration during the initial design phase, and that design safeguards and/or adequate administrative controls should be incorporated to ensure that the isotopic power device will not present a hazard to the general public, either under normal conditions or reasonably forseeable accident conditions. R.LI.

N67-16726*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
50-KW(E) THERMIONIC REACTOR STUDY
J. P. Davis *In its* Space Programs Sum. No. 37–41, Vol. IV 31 Oct. 1966 p 118–119 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

A study was initiated to analyze the potential of a nuclear powered electric propulsion system in the specific weight range of 40 to 60 lb/kw(e) with a 10^4 hr (full power) operating life, delivering 50 kw(e) to an ion engine. In particular, the study sought to compare the various nuclear cycle concepts as applied to this power range with regard to reactor, shielding, conversion machinery, radiator, and power conditioning requirements. Initial calculations were made for a minimum power thermionic reactor using NaK-78 coolant and operating at temperatures permitting the use of stainless steel for the fluid circuit. A table of reactor design characteristics and a weight breakdown of major elements are given. R.N.A.

N67-16727*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THERMIONIC REACTOR STABILITY STUDIES
H. Gronroos and J. Shapiro *In its* Space Programs Sum. No. 37–41, Vol. IV 31 Oct. 1966 p 119–124 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

Studies are being conducted to delineate the stability and control problems of a space in-pile thermionic reactor power plant. The stability problems are related to positive doppler coefficients associated with the highly enriched fuel needed in small fast reactors. Control may be a problem because the thermionic system has a narrow acceptable region of operation. Concurrent with direct simulation of system models on an analog computer, analytical work was conducted to interpret the measured responses and to derive stability criteria. A simulated lumped parameter thermionic reactor model is schematically shown. Nonlinear elements are introduced by neutron kinetics, diode current-voltage characteristics, and the energy transfer in the inter-electrode gap. The analytical complexities associated with the nonlinear elements prompted investigations of the effect of linearization of the system equations. Individual nonlinear elements in the analog simulation were linearized, and the changes in the responses were observed. Some results of these studies and those from a linear stability analysis are discussed. R.N.A.

N67-16238# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
SOME ASPECTS OF OPTIMIZATION OF ORGANIC COOLED REACTORS
T. J. Swierzawski *In its* Nukleonika, Vol. VIII 1966 p 139–145 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

In connection with organic-cooled nuclear reactors the question arises as to what percentage of degradation products should be kept in the cooling system. In this paper a rough sketch is presented which covers a solution of the problem from the point of view of power requirements for pumping the organic through the core of the reactor. Author

N67-16253# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
APPROXIMATE DETERMINATION OF THE FLOW AND TEMPERATURE FIELD IN A PEBBLE-BED GAS-COOLED REACTOR (NUMERICAL EXAMPLE) [PRZYBLIZONE OBLICZENIA POLA PREDKOSCI I POLA TEMPERATUR CZYNNIKA GAZOWEGO W PRZYPADKU PRZEPLYWU PRZEZ SRODOWISKO USYPANE ZLOZONE Z ELEMENTOW KULISTYCH (PRZYKLAD LICZBOWY)]
B. Krajewski and J. Szczurek *In its* Nukleonika, Vol. VIII 1966 p 228–235 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The paper gives a numerical example along with graphical illustrations, of calculations of the flow and temperature field in gas flowing through packed beds. The analysis is made for a case in which the thermal conductivity of the gas is negligible and the total pressure of the gas is assumed constant within the range considered. This problem can be reduced to one of finding a differential solution in partial derivatives with given conditions. Since the differential equation under consideration corresponds to a variational problem, the Ritz method was used to find the approximate solution. Author

N67-16261# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
THIRD INTERNATIONAL CONFERENCE ON THE PHYSICS AND ENGINEERING OF EXPERIMENTAL REACTORS, PRAGUE, APRIL 22 TO 28, 1963 [III MIEDZYNARODOWA KONFERENCJA FIZYKI I TECHNIKI REAKTOROW DOSWIADCZALNYCH, PRAGA, 22–28 KWIECIEN 1963 R.]
W. Dabek *In its* Nukleonika, Vol. VIII 1966 p 263–265 (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

A brief summary is presented of the conference including topics of the papers and investigation results. Physics papers were concerned with problems such as critical experiments, reactor oscillators, reactor theories, neutron flux measurements, and neutron spectra. Engineering papers dealt with reactor improvements, reactor loops, start-up and control, radiation protection, and critical assembly safeguards. A.G.O.

N67-16281# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
SOME EXPERIMENTS ON ABSORPTION CROSS SECTION DETERMINATION BY THE PILE OSCILLATOR METHOD IN THE REACTOR "EWA" [NEKOTORYE ISSLEDOVANIYA SVYAZANNYE S IZMERENIYAMI NEITRONNYKH SECHENII POGLOSHCHENIYA NA REAKTORE METODOM REAKTORNOGO OSTSILLYATORA]
J. Bouzyk, W. Suwalski, and J. Topa *In its* Nukleonika, Vol. VIII 1966 p 412–419 refs Presented at the 3d Intern. Conf. on the Phys. and Technol. of Exptl. Reactors, Prague, Apr. 1963 (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The present paper describes the further development of the measurements, i.e., investigation of various states and shapes of the samples as well as selfscreening in the samples. The sensitivity and accuracy have been increased considerably by a reduction in the diameter of the measuring channel. The water layer surrounding this channel softened the neutron spectrum in the channel. The slowing-down effect of the light elements has been studied. The absorption cross sections of some elements have been measured with an accuracy to within 5%. Results indicate the possibility of neutron cross section measurements for elements with weak resonance absorption. Author

N67-16283# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
OPERATION OF THE WWR-S REACTOR IN POLAND IN 1961–1962 [ISPOL'ZOVANIE I EKSPLYATATSIYA REAKTORA TIPA VVR-S V POL'SHE V 1961–1962 GODAKH]

J. Aleksandrowicz *In its* Nukleonika, Vol. VIII 1966 p 432–453 Presented at the 3d Intern. Conf. on the Phys. and Technol. of Exptl. Reactors, Prague, Apr. 1963 (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

This paper presents the experimental equipment used in work at horizontal reactor channels. The diagrams of the utilization of the nominal reactor power and of the core loading are given (the reactivity fractions of the separate fuel assemblies are denoted), together with the diagram of reactivity vs. burn-up. The reactor channels and other space used for sample irradiation and isotope production are described, and the total number of irradiations is given. The results of the measurements involved in routine reactor operation are given, namely: analysis of water purity in the primary circuit, analysis of the operation of the ion-exchanger and the mechanical filter, and analysis of the air activity in the special ventilating system. The paper also provides data concerning the radiation protection of the personnel, including individual monitoring. The testing of fuel elements for leaks is also discussed. Finally, cases of damage of the reactor equipment and of the appearance of alarm signals are described. Author

N67-16287# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

INVESTIGATION OF THE COOLING IN THE WWR-S REACTOR FUEL ELEMENT IN CYLINDRICAL CHANNELS AND IN A CHANNEL WITH A VARIABLE CROSS-SECTION IN THE WATER LOOP [ISSLEDOVANIE OKHLAZHDENIYA TEPLOVYDELYASHCHEGO ELEMENTA REAKTORA VVR-S V TSILINDRICHESKIKH KANALAKH I V KANALE S PEREMENNYM SECHENIEM V VODYANOI PETLE]

W. Byszewski, M. Slechta, and J. Aleksandrowicz *In its* Nukleonika, Vol. VIII 1966 p 473–493 refs Presented at the 3d Intern. Conf. on the Phys. and Eng. of Exptl. Reactors, Prague, Apr. 1963 (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The experimental equipment and the method of tests and measurements in the water loop of the Polish WWR-S reactor are described. The results of the measurements show that the heat transfer has been intensified and the surface temperature distribution along the fuel element has been flattened owing to variation of the channel cross-section. The experimental results are compared with theoretical calculations carried out according to various formulas. The experimental data are used to deduce a formula for calculating local heat transfer coefficients. These experimental results constitute a basis for an increase in the nominal power of the WWR-S reactor when new fuel assemblies are used with channels of variable cross-section. Author

N67-16295# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

INVESTIGATION OF THE INFLUENCE OF A SCATTERING SAMPLE ON NEUTRON TEMPERATURE DISTRIBUTION IN THE WWR-S REACTOR CORE

T. Rzeszot and E. Warda *In its* Nukleonika, Vol. VIII 1966 p 547–552 refs Presented at the 3d Intern. Conf. on Reactor Phys. and Eng., Prague, Apr. 1963 (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

Neutron scattering samples (water, graphite, lead) have been placed in an aluminum tube passing through the reactor core in order to investigate their influence on neutron temperature distribution. Measurements have been performed by the boron-glass filter method. The neutron temperature distribution in the reactor core has been measured by shifting the scattering sample along the tube. Author

N67-16296# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

MEASUREMENTS OF NEUTRON DIFFUSION PARAMETERS IN WATER USING A FAST CHOPPER

Zb. Ogrzewalski, T. Rzeszot, E. Warda, and A. Graffstein *In its* Nukleonika, Vol. VIII 1966 p 553–557 refs Presented at the 3d Intern. Conf. on Reactor Phys. and Eng., Prague, Apr. 1963 (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

Neutron diffusion parameters were measured using the fast chopper operating at one of the horizontal channels of the reactor. The conditions in which the fast chopper may be used for neutron life time measurements in water have been investigated. In general the results of the $\alpha = f(B^2)$ dependence for several sizes of water samples are consistent with the results obtained by other authors. The method used makes possible in some cases the pulsation of the thermal neutron beam which seems very promising because of the diminished neutron leakage during slowing-down in the moderator. Author

N67-16297# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

THE RELEASE OF FISSION PRODUCTS FROM A LEAKY FUEL ELEMENT [EMISSIYA PRODUKTOV DELENIYA IZ NEGERMETICHNOGO TEPLOVYDELYAYUSHCHEGO ELEMENTA REAKTORA]

K. Zarnowiecki, B. Filipiak, and M. Czerniewski *In its* Nukleonika, Vol. VIII 1966 p 558–563 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The behavior of gaseous fission products in reactor fuel is discussed, special attention being paid to the probable mechanism of fission gas release from reactor fuel elements. The observed release of fission products from a leaky fuel element can be explained by a theory outlined. Author

N67-16312# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

SECOND YUGOSLAV–POLISH SYMPOSIUM ON URANIUM TECHNOLOGY AND METALLURGY [II JUGOSLOWIANSKO–POLSKIE SYMPOZJUM W SPRAWIE TECHNOLOGII I METALURGII URANU]

K. Pinkas *In its* Nukleonika, Vol. VIII 1966 p 660–661 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The papers presented at the conference are listed, along with the Yugoslav and Polish research institute delegations which attended. M.G.J.

N67-16313# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

"AGNIESZKA" MECHANICAL RESONANCE-NEUTRON SELECTOR, PART I [MEKHANICHESKII SELEKTOR REZONANSNYKH NEITRONOV "AGNESHKA", CHAST I]

A. Graffstein and Z. Wilhelmi *In its* Nukleonika, Vol. VIII 1966 p 662–672 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

Technical assumptions concerning the construction of a resonance–neutron velocity selector are discussed. The device operates on the principle of time-of-flight measurement, with its basic systems comprising a microsecond beam chopper, a neutron detector, an electronic time distribution analyzer, and various auxiliary instrumentation. A neutron beam leaving a horizontal channel (diameter 100 mm) of the reactor is shaped by means of collimators built of iron, lead, and plexiglass. Details are also given on the experiments which led to the design. M.G.J.

N67-16319# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

"AGNIESZKA" MECHANICAL RESONANCE-NEUTRON SELECTOR, PART II [MEKHANICHESKII SELEKTOR REZONANSNYKH NEITRONOV "AGNESHKA", CHAST II]

A. Graffstein and Z. Wilhelmi. *In its* Nukleonika, Vol. VIII 1966 p 731–744 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The resonance-neutron selector built and put into operation in the Nuclear Research Institute in Warsaw is described in detail and some results of operation are presented. Author

N67-16385# Battelle Memorial Inst., Columbus, Ohio.
COMPARISON OF THE RADIATION STABILITY OF UO_2–ZrO WITH THAT OF UO_2 AND UO_2–BeO
James H. Saling, Thomas R. Wright, and Earle O. Fromm 15 Aug. 1966 43 p refs
(Contract W-7405-ENG-92)
(BMI-1782) CFSTI: HC $3.00/MF $0.65

The radiation stability of UO_2–29.9 wt % ZrO_2 was compared with that of bulk UO_2 and UO_2–29.4 wt % BeO dispersions at surface temperatures from 770 to 950°C and at burnups ranging from 12.4 to 14.8 × 10^{20} fissions per cm^3. Dimension and density measurements indicated that the UO_2–ZrO_2 fuel swelled more than the UO_2 or UO_2–BeO fuels. Significant microstructural changes were some mutual solubility of the UO_2 and BeO at the lowest irradiation temperature, evidence of the initiation of a columnar grain structure in the UO_2–ZrO_2, evidence of a reaction between the UO_2–ZrO_2 and the Hastelloy X cladding, and corrosion of the Hastelloy X cladding by Na. X-ray-diffraction and metallographic studies indicated that the central regions of the UO_2–ZrO_2 had transformed from a multiphase to a single-phase cubic structure. Under the test conditions described, the radiation stability of the UO_2–ZrO_2 did not compare favorably with that of either the UO_2 or the UO_2–BeO. Author (NSA)

N67-16479# Naval Research Lab., Washington, D. C.
NEUTRON SPECTRAL CONSIDERATIONS AFFECTING PROJECTED ESTIMATES OF RADIATION EMBRITTLEMENT OF THE ARMY SM-1A REACTOR PRESSURE VESSEL
C. Z. Serpan, Jr. and L. E. Steele 30 Sep. 1966 31 p refs
(NRL-6474; AD-641283) CFSTI: HC $3.00/MF $0.65

The pressure vessel of the Army SM-1A reactor is located close to the active core in such a manner that the neutron exposure is relatively high; consequently, the pressure vessel steel undergoes a relatively rapid rise in the ductile-brittle transition temperature. The maximum permissible delta NDT for the SM-1A is established by the Army as 340F. Since it is physically impossible to irradiate surveillance test specimens at the SM-1A vessel wall, only the neutron flux was measured at the wall, and representative test specimens were irradiated in a test reactor, the Low Intensity Test Reactor (LITR). In translating the delta NDT versus neutron exposure data from the LITR to the case of the SM-1A reactor vessel wall, the neutron spectra of the two reactors were used to adjust both the SM-1A reactor vessel flux and the LITR exposure values in terms of n/sq cm < 1.0, 0.5, and 0.183 Mev. Since the distribution of neutrons by energy groups was different within each reactor at the specific location of interest, that is, the vessel wall of the SM-1A and an in-core location of the LITR, the damaging potential of the SM-1A reactor spectrum location was related to that of the LITR. With damage equivalence established between the two reactors, a critical neutron exposure (n/sq cm > 0.5 Mev) may be projected for producing the maximum delta NDT on the SM-1A reactor vessel wall. By relating this critical exposure to SM-1A reactor operations, a critical power output level of 67 Mw-yr was established. Author (TAB)

N67-16521# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
STEP PROJECT Quarterly Technical Report, Apr.–Jun. 1966
K. A. Dietz, ed. May 1966 115 p refs
(Contract AT(10-1)-205)
(IDO-17145) CFSTI: HC $3.00/MF $0.65

The SNAPTRAN program during this period consisted primarily of transient testing of the SNAPTRAN-1 reactor. The tests, performed to determine the kinetic behavior of fast response SNAP reactors, were conducted using two-drum impulse, two-drum step, and one-drum impulse reactivity insertions. Design and analysis efforts on the LOFT facility and experimental system included the design of a halogen and particulate filter system, the design of a fission product sampling system, and the analysis of the blowdown and water-hammer forces on the primary coolant system and the reactor flatcar or dolly. Zirconium-clad critical assemblies were reviewed, and the design of the LOFT core was modified to reflect the change from stainless steel fuel cladding to zirconium fuel cladding. An analytical model for describing the pressure and temperature within the containment vessel was developed as part of the design and safety analysis of a water-cooled nuclear reactor plant. The explicit pin model of heat transfer during meltdown and the steam separation model of two-phase blowdown were evaluated through numerical computations. Wet chemistry separation and absorption of iodine on boron nitride were investigated and evaluated as possible methods of fission product analysis. Instrumentation studies were conducted in which new measurement techniques were investigated and evaluated, and measuring devices were developed that have capabilities beyond those of the standard state-of-the-art devices. Author (NSA)

N67-16523# Oak Ridge National Lab., Tenn. Nuclear Safety Information Center.
INDEXED, BIBLIOGRAPHY OF CURRENT NUCLEAR SAFETY LITERATURE—5
Jun. 1966 214 p refs
(Contract W-7405-ENG-26)
(ORNL-NSIC-16) CFSTI: HC $3.00/MF $0.65

Approximately 900 references are given to reports, journals, and books published through Jan. 1966. Nineteen categories are included for information relevant to the analysis and control of hazards associated with nuclear reactors, operations involving fissionable materials, and the products of nuclear fission. Primary emphasis is on safety in reactor design, construction, and operation; however safety considerations in reactor fuel fabrication, spent-fuel processing, nuclear waste disposal, and related operations are also included. NSA

N67-16524# Oak Ridge National Lab., Tenn. Nuclear Safety Information Center.
THE INTEGRITY OF REACTOR PRESSURE VESSELS
E. C. Miller May 1966 61 p refs
(Contract W-7405-ENG-26)
(ORNL-NSIC-15) CFSTI: HC $3.00/MF $0.65

Some of the significant information relevant to the long-time integrity of nuclear reactor vessels is reviewed and presented as a brief critical survey. Nuclear-related accidents were studied to determine if penetrations or ruptures of pressure boundaries—either as cause or result—were involved. The records of service performance (and failures) of non-nuclear equipment—boilers, pressure vessels, and piping—were examined for information significant to reactor vessel performance. The extensive literature on factors holding failure-contribution potential was reviewed to determine their relevance to probable reactor vessel performance; these include: structural adequacy as determined by design, materials and fabrication; service deterioration resulting from chemical, mechanical, thermal, metallurgical, or radiation causes; growth of flaws by thermal or mechanical fatigue cycling; high temperature creep; rupture by brittle fracture of ductile tear and, of course, human errors. Measures that can contribute to reliability of vessels are discussed. Author (NSA)

N67-16525# Union Carbide Nuclear Co., Oak Ridge, Tenn.
POWER METALLURGY OF URANIUM MONOCARBIDE

C. R. Schmitt 13 Apr. 1966 33 p refs
(Contract W-7405-ENG-26)
(Y-1510) CFSTI: HC $3.00/MF $0.65

Several studies were conducted to determine ways of producing satisfactory pellets of uranium monocarbide. It was found that densification by cold pressing is dependent upon the powder particle size, oxygen content, sintering temperature and atmosphere, and the lubricant used in pressing. Certain sintering promoters were investigated. The addition of approximately 0.5% nickel was found to enhance densification, and an average density of 97% of theoretical was obtained when 2 wt % uranium disilicide was used under the proper conditions. Author (NSA)

N67-16526# Atomics International, Canoga Park, Calif.
AEC UNCLASSIFIED PROGRAMS, OCTOBER–DECEMBER 1965 Quarterly Technical Progress Report
15 Feb. 1966 147 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11805) CFSTI: HC $3.00/MF $0.65

Progress is reported on boiling studies for Na reactor safety, effects of high-temperatures and fast neutrons on cladding and structural materials, operation of SRE, sodium components test installation operation, high-temperature strain measurements, reactions of high-temperature Na, PNPF fuel studies, SAP-clad UC fuel development, design of PNPF Core-II, PNPF coolant make-up studies, diffusion of neutrons in graphite, development and production of nuclear data, fast-spectrum Doppler measurements, reactor theory improvement, refractory cermet development, refractory moderator development, effects of fission in metal fuels, studies of ternary zirconium hydrides, preparation and analysis of pure Na, Doppler coefficient studies, studies of Na fires, studies on high-temperature chemistry, radiation chemistry studies, electronic structure studies of metals, and radiation damage in crystalline solids. Author (NSA)

N67-16533# Argonne National Lab., Ill.
CATALOG OF NUCLEAR REACTOR CONCEPTS. PART I HOMOGENEOUS AND QUASI-HOMOGENEOUS REACTORS. SECTION V: REACTORS FUELED WITH URANIUM HEXAFLUORIDE, GASES, OR PLASMAS
Charles E. Teeter, James A. Lecky, and John H. Martens Mar. 1966 50 p refs
(Contract W-31-109-ENG-38)
(ANL-7180) CFSTI: HC $3.00/MF $0.65

Brief descriptions of reactors fueled with uranium hexafluoride, either as a gas or a liquid, and those fueled with other gases (such as vaporized fissile metals) or with plasmas are presented in

N67-16536# Atomics International, Canoga Park, Calif.
SNAP 10A FSM-4 SYSTEM TEST
Paul L. Soske 25 May 1966 80 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11814) CFSTI: HC $3.00/MF $0.65

FSM-4 is a non-nuclear test system designed to provide preflight qualifications for SNAP 10A. The FSM-4 test system duplicated in every detail the SNAP 10A unit except for the nuclear heat source, which was simulated in the FSM-4 tests by electric heating. Before the flight system could be launched, FSM-4 was required to demonstrate successful performance in surviving the startup temperature transient. The FSM-4 testing had four objectives: (1) shock and vibration testing of a NaK-loaded system; (2) simulated orbital operation before startup; (3) simulated orbital startup sequence with emphasis on the transient; and (4) thermal reference endurance testing. The FSM-4 tests demonstrated that the flight system would produce rated power after being subjected to launch and orbital environment. The endurance testing indicated problem areas where additional inspection and modification on the flight system were required. Author (NSA)

N67-16537# Oak Ridge National Lab., Tenn.
REACTOR YIELD CALCULATIONS FOR 81 RADIOISOTOPES PRODUCED BY (N, γ) REACTIONS AT FLUXES OF 10^7 TO 10^{16} N/CM^2-SEC FOR IRRADIATION TIMES OF 30 MINUTES TO ONE YEAR
T. C. Whitson and C. W. Friend Apr. 1966 87 p refs
(Contract W-7405-ENG-26)
(ORNL-IIC-8) CFSTI: HC $3.00/MF $0.65

Calculations of reactor yields in curies per gram of target material are listed in tables for 81 radioisotopes at 21 flux values, from 10^7 to 10^{16} n/cm^2-sec, and irradiation times from 0.5 hour to 1 year. The reaction and decay schema used in the calculations for each radioisotope is given, and the method of calculation using the computer program ISOTOPES is outlined. Author (NSA)

N67-16539# Atomics International, Canoga Park, Calif.
RADIOLOGICAL ASPECTS OF REENTRY BURNUP OF SNAP REACTORS
C. A. Willis 25 Mar. 1966 36 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-11761) CFSTI: HC $3.00/MF $0.65

Reentry burnup of SNAP reactors may produce low levels of worldwide fallout. The International Commission on Radiological Protection has recommended a population dose limit of 2 rem in 30 yr. The factors affecting the choice of a population dose criterion are reviewed in this report. These factors include radiological safety history and tradition, radiobiological knowledge, other radiation criteria, and the biological significance of criteria doses. No safety justification is found for reduction in the ICRP limit. This 2-rem in 30-yr dose is well within the range of variation of natural background radiation. Population safety requirements are satisfied if the dose is less than the ICRP criterion. Many possible sources of artificial, nonmedical radiation could contribute to the population dose. For planning purposes, it is recommended that one-eighth the population dose, 0.25 rem/30 yr, be taken as the allowable dose from SNAP reactor applications. (118 references.) Author (NSA)

N67-16632*# Cincinnati Univ., Ohio.
TRANSIENT RADIATION EFFECTS ON THERMOCOUPLES
J. H. Leonard and J. S. Crutchfield [1966] 19 p refs Presented at the 1966 Winter Meeting, Am. Nucl. Soc., Pittsburgh, Oct. 30–Nov. 3, 1966
(Grant NGR-36-004-014)
(NASA-CR-81333) CFSTI: HC $3.00/MF $0.65 CSCL 18D

Thermocouples of the type used in many power reactors were exposed to various levels of nuclear radiation in the AF–NETR reactor while immersed in a constant temperature medium. Measurements of voltage output obtained under these conditions indicate the existence of pronounced and reproducible transient changes in calibration of 15°F or more. The effects appear dependent on the level and possibly the rate of change of level of incident radiation. This magnitude of calibration change may be large enough to be of considerable significance in interpretation of in-pile thermocouple data. Author

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N67-15468# Hokkaido Univ., Sapporo (Japan). Inst. of Low Temperature Science.
DISORDER ENTROPY OF ICE

Yosio Suzuki 1966 46 p refs *Its* Contrib. from the Inst. of Low Temp. Sci., Ser. A, No. 21
(Rept.-775) CFSTI: HC $3.00/MF $0.65

Additional entropy of ice due to random arrangements of hydrogen atoms is strictly defined for a finite ice crystal, consisting of n water molecules and having f surface free bonds. The entropy, S, thus defined, is called the disorder entropy of the crystal and is shown to be given by $S/k = n(\ln(3/2) + 1n\ q_\infty) + f(1n\ 2 - \delta)$, where K is Boltzmann's constant, q_∞ is a definite quantity, depending on the structure of the oxygen lattice, and δ is a positive quantity, depending on the detailed form of the crystal. For the wurtzite-like oxygen lattice and for the two-dimensional square oxygen lattice, q_∞'s are concretely defined and a method for enumeration of approximate values of them is given. In particular, for the two-dimensional square lattice, two series of quantities, q(b, ∞, ∞) and s(∞, b), converging to q_∞ with b from the underside and from the upperside respectively and each term of them being exactly enumerable, are defined so as to enable one to obtain the value of q_∞ to the desired accuracy. The values of q(b, ∞, ∞) are given for b being up to seven. Author

N67-15695*# National Aeronautics and Space Administration, Washington, D. C.
STABILITY OF SYSTEMS WITH DELAY
S. N. Shimanov Dec. 1966 16 p refs Transl. into ENGLISH from Anal. Mekh., Ustoychivost' Dvizheniya, Nebesnaya Ballistika, Moscow, 1965 p 170–180 Presented at the 2d All-Union Conf. on Theoret. and Appl. Mech., Moscow, 29 Jan.–5 Feb. 1964
(NASA-TT-F-10488) CFSTI: HC $3.00/MF $0.65 CSCL 12A

The article surveys work dealing with the stability of motion of systems described by differential equations with an aftereffect or time delay. The methods of investigating systems with an aftereffect (the method of Lyapunov functions, the universal method of Lyapunov functionals) are described, and an overall approach to the problem is outlined. A study is made of the theory of linear differential equations with an aftereffect. Certain new results of general nature concerning the theory of linear periodic systems with an aftereffect are cited. First-approximation stability is discussed, and a study is made of the stability of systems with an aftereffect in critical cases. Author

N67-15740*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
JUNCTION CONDITIONS IN GENERAL RELATIVITY
F. B. Estabrook and H. D. Wahlquist *In its* Space Programs Sum. No. 37–41, Vol. IV 31 Oct. 1966 p 189 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

It is reported that tetrad and dyadic formulations of the junction conditions were obtained, and may be used to formulate exact, but discontinuous solutions of the Einstein field equations. This tetrad language does not require the use of admissible coordinates or the use of a continuous reference tetrad frame. Also reported is that an interesting set of discontinuous, spherically symmetric, nonstatic, exact solutions were obtained. C.T.C.

N67-15999# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering.
IMPLEMENTATION OF POYNTING VECTOR MEASUREMENTS Final Report, 1 Jan. 1965–7 Jul. 1966
W. W. Cowles 31 Aug. 1966 63 p refs
(Contract NBy-32219)
(Rept.-67-05; AD-640990) CFSTI: HC $3.00/MF $0.65

This report covers the design, construction, and field testing of an experimental device capable of measuring the magnitude of the Poynting vector associated with an electromagnetic field. With mechanical manipulation, it can determine the direction of the Poynting vector. It is based upon theory which has been described previously. Tests of the final device demonstrate that it is capable of measuring this quantity with reasonable accuracy. The major limitations on its use result from the necessity for obtaining an accurate phase calibration of the two separate channels used for amplifying the signals received respectively on the rod and the loop antenna. Interaction between the rod and the loop does not seem to be a significant problem. The device has unique characteristics and a number of applications for it are indicated. Recommendations on improvements in the device which are desirable for general field use are included. Author (TAB)

N67-16002*# National Academy of Sciences–National Research Council, Washington, D. C.
GENERAL SESSION—ALL COMMISSIONS
In its Progr. in Sci. Radio 1966 p 39–47 (See N67-16001 06-34) CFSTI: HC $3.00/MF $0.65

Provided is a synopsis of radio work going on in COSPAR, highlights from a symposium on solar-terrestrial physics, a progress report on synchronization of clocks by means of satellites, and on unique radio frequencies from space. Artificial satellites can be used for the transfer of precise time and frequency either as relay systems, or as clock-carrying devices; various experiments indicate that the use of satellites to synchronize between ground stations to about 0.01 μsec seems feasible. This provides frequency calibration from time differences of 1 part in 10^{13} in one day. A discussion on international radio frequency allocations led to the recommendation that all OH frequencies be reserved at 1,612, 1,665, 1,667, and 1,720 MHz for radio astronomical studies. G.G.

N67-16003*# National Academy of Sciences–National Research Council, Washington, D. C.
RADIO STANDARDS AND MEASUREMENTS
In its Progr. in Sci. Radio 1966 p 49–94 refs (See N67-16001 06-34) CFSTI: HC $3.00/MF $0.65

A summary report is presented on the several problems considered in the scientific sessions, as well as the administrative actions proposed by the delegates. In discussing standard frequency transmission, attention was focused on the increasing accuracy in the long distance distribution of standard time and frequency by vlf radio transmission, by microwave transmission via artificial satellite, and by carrying portable clocks from point to point; and on worldwide coordination of UT and AT. Theories pertaining to the velocity of light and electromagnetic waves were assessed, and several aspects relating to atomic standards of time were considered. Consideration was also given to international comparisons of radio frequency quantities, and to standards in precision coaxial connectors. Modern radio measurement techniques were outlined. Emphasis was also placed on rf measurements at frequencies below 1GHz, and above 1GHz including optical techniques. M.G.J.

N67-16006*# National Academy of Sciences–National Research Council, Washington, D. C.
RADIO WAVES AND CIRCUITS
In its Progr. in Sci. Radio 1966 p 307–346 refs (See N67-16001 06-34) CFSTI: HC $3.00/MF $0.65

Topics depict: (1) *Diffraction and Scattering in Nonionized Media*—two-dimensional electromagnetic wavefields, scattering operator, and formulations of scalar diffraction and scattering problems; (2) *Coding, Modulation, and Signal Processing*—information theory, coding, and adaptive communications systems; (3) *Antennas*—large antennas and arrays, and information processing systems with antennas; (4) *Nonlinear Circuits*—theoretical results, and functional-analytic techniques for nonlinear circuits and systems; (5) *Linear Circuits*—advanced in linear circuit theory, and progress in circuit formulations; (6) *Electromagnetic Properties of Ionized Media I: Source-Free Solutions in Ionized Regions*—plasma theory, and wave problems in plasmas; (7) *Electromagnetic Properties of Ionized Media II: Radiation and Scattering in Ionized Regions*—dispersion-relations in anisotropic

cold plasmas and isotropic warm plasmas, boundary conditions for antennas in ionized media, and antennas in plasmas. G.G.

N67-16018* Maryland Univ., College Park.
ONSET OF LONG-RANGE ORDER IN A CRITICAL SOLUTION OF MACROMOLECULES
J. A. White, J. S. Osmundson, and B. H. Ahn *In its* Study of the Phys. of Laser Radiation 15 Oct. 1966 4 p refs Repr. from Phys. Rev. Letters, v. 16, no. 15, 11 Apr. 1966 p 639–642 (See N67-16014 06-16) CFSTI: HC $3.00/MF $0.65
(Contract ARPA SD-101)

Diffusion broadening has been observed in the inelastic scattering of monochromatic light off a binary fluid, cyclohexane–polystyrene, near its critical point for mixing. The broadening a few tenths of a degree above the critical temperature is an order of magnitude less than in a binary mixture of small molecules (cyclohexane–aniline) and two orders of magnitude less than in a pure fluid (SF_6). The depencence of the broadening on scattering angle agrees with that found for the other fluids, and with expectation; but its increase with rising temperature is less rapid than for these fluids, being less than linear in ΔT. Author

N67-16019* Maryland Univ., College Park. Dept. of Physics and Astronomy.
DYNAMICAL COMPUTATION OF PHOTON CORRELATIONS AND COUNTING STATISTICS
Victor Korenman *In its* Study of the Phys. of Laser Radiation 15 Oct. 1966 31 p refs (See N67-16014 06-16) CFSTI: HC $3.00/MF $0.65
(Contract ARPA SD-101; Grant AF-AFOSR-735-65)

Equations of motion are derived for generating functions of field correlations and detector counting probabilities for an arbitrary system of electromagnetic fields in the presence of their sources. For a system with linear constitutive relations the equations are solved exactly. Such systems are shown to be always Gaussian and some representative counting distributions are computed. A perturbative treatment of a system with a cubic nonlinearity in its constitutive relation is made to find the counting distribution to first order in the nonlinear coefficient. A comparison is made with the below threshold limit of a recent laser fluctuation theory and a possible application to measurement of phonon–phonon interactions is mentioned. Author

N67-16020* Maryland Univ., College Park.
POLARIZATION AND ABSORPTION EFFECTS ON THE FRAUNHOFER DIFFRACTION PATTERNS OF A CORNER REFLECTOR
C. O. Alley, R. F. Chang, D. G. Currie, and M. E. Pittman *In its* Study of the Phys. of Laser Radiation 15 Oct. 1966 26 p refs (See N67-16014 06-16) CFSTI: HC $3.00/MF $0.65

To investigate the possibility of ranging the moon with an optical radar system on the ground and the corner reflectors on the moon, the far field diffraction pattern of a geometrically perfect corner reflector, especially the effects of the relative phase shifts between different polarizations caused by total internal reflection, is considered. Attention is focused on the energy concentration of the signal returning from the moon. The far field pattern produced by combining beams of different polarization emerging from six sectors of the corner reflector is investigated, and the polarization and amplitude of each beam determined by the optical properties of the rear interface between the corner material and a metal or a dielectric. The properties of specific interfaces, and the symmetries of some diffraction patterns for silver, aluminum, and total internal reflection are discussed. Photographs of the Fraunhofer diffraction pattern, which seem to confirm the treatment and approximations made, are reproduced. R.Li.

N67-16058*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
OCTAVE AND ONE-THIRD OCTAVE ACOUSTIC NOISE SPECTRUM ANALYSIS
Charles D. Hayes and Michael D. Lamers 15 Jan. 1967 18 p refs
(Contract NAS7-100)
(NASA-CR-81251; JPL-TR-32-1052) CFSTI: HC $3.00/MF $0.65 CSCL 20A

This Report is a compilation of derivations for analyzing acoustic noise spectra. These derivations consist of mathematical techniques for: combining the decibel levels of either octaves or constant bandwidths into an overall spectrum level; determining the octave levels in a second octave system when the levels in the first octave are known; and determining one-third octave levels when the octave levels and the decibel-per-octave slope are known. The Appendixes also contain the following useful tables: Table of the New and Old A.S.A. (American Standards Association) Recommended Octave Designations; Table of Decibel Equivalents for Power, Voltage, and Pressure; and Conversion Table for Some Useful Acoustic Constants. These mathematical techniques and tables provide useful information for the engineer or scientist working in the field of acoustics. Author

N67-16093*# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
CRYOGENIC RESEARCH AND DEVELOPMENT Twenty-Third Progress Report, Period Ending Sep. 30, 1966
30 Sep. 1966 37 p ref
(NASA Order R-45)
(NASA-CR-81265; NBS-9261) CSCL 20M

Project status, objectives, experiments, and future plans are outlined for various research projects in the field of cryogenics, including cryogenic metrology, the physical properties of cryogenic fluids, cryogenic flow processes, liquid–solid hydrogen studies, and the thermal conductivity of solids. The final program codes for hydrogen properties are also included, i.e., specific heat and sound velocity as functions of pressure and enthalpy. L.E.W.

N67-16095# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NEWS OF INSTITUTIONS OF HIGHER LEARNING. PHYSICS Selected Articles
18 Apr. 1966 24 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Fiz. (Tomsk), no. 3, 1964 p 3–6, 72–77 (FTD-TT-65-762; TT-66-62411; AD-640225) CFSTI: HC $3.00/MF $0.65

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1. MODELING OF PARTICLE MOVEMENT IN OVERLAPPING ELECTRICAL AND MAGNETIC FIELDS N. V. Trikhanova and P. M. Shchanin p 1–6 refs (See N67-16096 06-24)

2. EFFECT OF A DIELECTRIC ON THE LENGTH RESONANCE LONGITUDINAL SLOTS AND TURN OF POLARIZATION OF WAVE H IN A ROUND WAVE GUIDE L. B. Shtrapenin p 7–15 refs (See N67-16097 06-23)

N67-16097# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF A DIELECTRIC ON THE LENGTH RESONANCE LONGITUDINAL SLOTS AND TURN OF POLARIZATION OF WAVE H IN A ROUND WAVE GUIDE
L. B. Shtrapenin *In its* News of Inst. of Higher Learning. Phys. 18 Apr. 1966 p 7–15 refs (See N67-16095 06-23) CFSTI: HC $3.00/MF $0.65

The inner and outer conductivity of a slot in the presence of a lossless dielectric in the interior of the waveguide was investigated. Formulas are presented for the conductivity and the turn of plane polarization of the wave. An installation used as an

experimental check is described, the basic part of which represents two rotating sections of a round waveguide. Diagrams of resonance curves and field distributions are included. N.E.N.

N67-16111# McGill Univ., Montreal (Quebec). Eaton Electronics Research Lab.
A CRYOGENIC MAGNET SYSTEM FOR QUASI-CONTINUOUS OPERATION
Richard Stevenson and Peter Marston (Magnetic Eng. Associates) Oct. 1966 11 p refs
(Contract Nonr-3013(00))
(TR-8; AD-641919) CFSTI: HC $3.00/MF $0.65

The general layout and design of a relatively inexpensive system to produce magnetic fields in the 200 and 300 koer region is described. The magnets are solenoids wound from high purity aluminum in a regionalized, stress-reduced configuration. Detailed stress analysis indicates that the solenoids can be built so that the stress in the conductor need not rise above the yield strength of the aluminum. A typical mechanical configuration of a solenoid is described. The coils are cooled by compressed helium gas at about 17K. The nature of the cooling load determines the mode of operation of the magnets, and the size of the associated cryogenic equipment. Author (TAB)

N67-16214# Rochester Univ., N. Y. Inst. of Optics.
THE ORTHONORMALIZATION OF ABERRATIONS
H. A. Unvala [1966] 37 p refs Presented at Intern. Conf. on Lens Design with Large Computers, Rochester, N. Y., 5–8 Jul. 1966
(Contract DA-30-069-AMC-534(A))
(AD-640395) CFSTI: HC $3.00/MF $0.65

An approach combining the insight provided by aberration theory with the advantages of automatic least squares defect reduction (with a minimum of restrictive assumptions) is outlined. The technique promises to be a worthwhile tool in designing lenses, particularly in combination with the complementary orthonormalization over the parameter space. Limitations of the method are briefly pointed out. L.S.

N67-16218# Polytechnic Inst. of Brooklyn, N. Y. Electrophysics Group.
THE FREQUENCY-POWER RELATION IN A TRAVELING-WAVE MODULATED DIELECTRICS
S. T. Peng and E. S. Cassedy 18 May 1966 14 p refs
(Contract AF 49(638)-1402)
(AFOSR-66-2333; PIBMRI-1327-66; AD-641014) CFSTI: HC $3.00/MF $0.65

In a steady state analysis, the Manley-Rowe frequency-power relation is shown to be valid for the propagation of electromagnetic waves through a dielectric medium which is modulated with a traveling acoustic wave. The Fourier amplitudes of the internal electromagnetic fields are exactly calculated and shown to satisfy this relation. In the pass band a net transfer of frequency-power is permitted. Frequency-power transfer vanishes in the stop band, but this does not imply zero transfer of real power. As an application, the frequency-power relation was used to find an invariant constraint on the scattering matrix of a two-part network formed by a traveling-wave-modulated transmission line section. It is shown that the scattering matrix is no longer unitary, that the modulated medium can give energy to or absorb energy from the signal waves, depending on the operation conditions. Author (TAB)

N67-16328# RAND Corp., Santa Monica, Calif.
EFFECT OF A COORDINATE MEASUREMENT ON THE STATISTICAL ENSEMBLE OF A QUANTUM MECHANICAL SYSTEM
A. E. Glassgold and Dennis Holliday Oct. 1966 28 p refs
(Contract AF 49(638)-1700; Proj. RAND)
(RM-5138-PR; AD-640688) CFSTI: HC $3.00/MF $0.65

A method is developed for discussing the measurement of quantum mechanical observables with continuous eigenvalue spectra. In this method, the Wigner distribution function has a role similar to that of the Gibbs phase space density in the corresponding classical problem. The analysis applies to a wide class of physical situations, such as a field or a material particle. Author (TAB)

N67-16368# Tennessee Univ., Knoxville. Ultrasonics Lab.
AN INVESTIGATION OF SUBHARMONIC GENERATION IN AN ULTRASONIC RESONANT CAVITY
William Ross McCluney (M.S.Thesis) Oct. 1966 104 p refs
(Contract Nonr-4289(01))
(TR-2; AD-641604) CFSTI: HC $3.00/MF $0.65

The generation of subharmonics of the driver frequency in an ultrasonic resonant cavity was investigated by means of both optical and electronic techniques. The subharmonics are found to be generated when the cavity is in resonance at the driver frequency. The frequencies of the subharmonics were observed to be integral sub-multiples of the driver frequency. An important result is that is not necessary for the cavity to be in resonance at the subharmonic frequency for the subharmonic to be generated. The relationship between this phenomenon and other phenomena, such as laser action, parametric amplification, and optical power limitation, is pointed out. Author (TAB)

N67-16437# McGill Univ., Montreal (Quebec). Eaton Electronics Research Lab.
A 100 KILOGAUSS QUASI-CONTINUOUS CRYOGENIC SOLENOID, PART I
Laszlo Lontai and Peter Marston (Boston Eng. Associates) 19 Oct. 1966 13 p
(Contract Nonr-3013(00))
(TR-9; AD-641920) CFSTI: HC $3.00/MF $0.65

A stress analysis is made of a solenoid intended for high field service at low temperatures. It is shown that a reduction in the stress level can be achieved by a mechanical regionalization of the windings. Author (TAB)

N67-16460# RAND Corp., Santa Monica, Calif.
DYNAMIC PROGRAMMING AND THE HAMILTON-JACOBI METHOD OF CLASSICAL MECHANICS
S. E. Dreyfus Oct. 1966 33 p refs
(Contract AF 49(638)-1700)
(RM-5116-PR; AD-640732) CFSTI: HC $3.00/MF $0.65

A new dynamic programming derivation is presented for the classical Hamilton-Jacobi method of solving optimization problems. The connections with the usual dynamic programming approach are developed and illustrated. Author (TAB)

N67-16519*# Illinois Univ., Urbana. Coordinated Science Lab.
LECTURES ON RELATIVITY THEORY
John Ray Aug. 1966 161 p
(Grant NsG-443; Contract DA-28-043-AMC-00073(E))
(NASA-CR-81281, R-311) CFSTI: HC $3.00/MF $0.65

The lectures were given to graduate and undergraduate engineering and science students during the spring semester, 1966. The lectures cover both the special and general theories. The coverage of the special theory is fairly complete while that of the general theory is somewhat abbreviated due to lack of time. The lectures on the general theory stopped with the derivation of the Schwartzschild solution and a discussion of the linear theory. Author (TAB)

N67-16538# Stanford Univ., Calif. Stanford Linear Accelerator Center.
A COMPUTER CODE FOR VARIABLE PERMEABILITY MAGNETOSTATIC FIELD PROBLEMS
E. A. Burfine, L. R. Anderson, and H. Brechna Apr. 1966 54 p refs
(Contract AT(04-3)-515)
(SLAC-56) CFSTI: HC $3.00/MF $0.65

A method for solving variable permeability two-dimensional and axially symmetric magnetostatic problems is discussed and the implementation of this method in the computer code NUTCRACKER is explained. Author (NSA)

N67-16547*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN INTEGRATING SPHERE COATING FOR THE VACUUM ULTRAVIOLET SPECTRAL REGION
James B. Heaney Dec. 1966 16 p refs
(NASA-TM-X-55645; X-713-66-571) CFSTI: HC $3.00/MF $0.65 CSCL 20F

The coating proposed here utilizes the fluorescent properties of sodium salicylate to enable an integrating sphere to operate in the region from 500Å to 2000Å. The sphere is first coated with a magnesium oxide pigmented paint which is both durable and highly reflecting in the spectral region at which sodium salicylate fluoresces. This substrate is then overcoated with a thin layer of sodium salicylate which is sensitive to the radiation reflected by the sample. At the same time, the substrate-fluorescecor combination is a relatively good diffuse reflector of the incident fluorescent radiation. A description of the spectrophotometer employed for this investigation is given together with results of measurements made on some diffusely reflecting materials. Author

N67-16583# Ballistic Research Labs., Aberdeen Proving Ground, Md.
CALCULATIONS OF LIGHT REFRACTION BY A BLAST BUBBLE
Aivars K. R. Celmins Aug. 1966 23 p refs
(BRL-MR-1781; AD-643310) CFSTI: HC $3.00/MF $0.65

The report describes some calculations concerned with observations of light refraction by a blast bubble. These calculations simulate such observations numerically in order to furnish data necessary for the planning of experiments. It is concluded from the results, that an evaluation process previously proposed by the author can be improved. Refraction observations with a standard error of ten seconds of arc are found accurate enough for the experimental setup assumed. Author (TAB)

N67-16620*# National Bureau of Standards, Boulder, Colo.
COOLDOWN OF CRYOGENIC TRANSFER LINES An Experimental Report
J. A. Brennan, E. G. Brentari, R. V. Smith, and W. G. Steward 7 Nov. 1966 75 p refs
(NASA Order R-45)
(NASA-CR-81338; NBS-9264) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Experimental data on pressure, temperature, and flow during cooldown of a transfer line are presented. Data using liquid hydrogen and liquid nitrogen are included in both subcooled and saturated liquid conditions. Calculated heat transfer coefficients are shown and compared to a steady state pool boiling correlation. Author

N67-16630*# North Carolina State Coll., Raleigh.
THE EFFECT OF NON-LINEARITIES ON OPTICAL CORRELATION PROCESSING
J. P. Moffatt and F. J. Tischer Nov. 1966 19 p refs
(Grant NGR-34-002-038)
(NASA-CR-81335; EML-2) CFSTI: HC $3.00/MF $0.65 CSCL 20F

This paper presents a method of analytically determining the effect of internal non-linearities on the output of a coherent optical correlator operated as a matched filter. Such a device employs photographic transparencies or other media for the representation of the reference and signal functions. These include distortions due to the non-linearities of the processes involved. The effect of the distortions on the output correlation functions is derived using a Taylor series expansion of the non-linearities. Three representative examples are considered to demonstrate the effect numerically.

N67-16644# Navy Electronics Lab., San Diego, Calif.
THREE-DIMENSIONAL HOLOGRAPHY
H. E. Morrow and N. F. Dessel 7 Sep. 1966 63 p refs
(NEL-1403; AD-643165) CFSTI: HC $3.00/MF $0.65

The development of holography is presented, along with a summary of the process, the difficulties, and likely applications. Three-dimensional holography is emphasized. A detailed description of experimental procedures includes an analysis of reasons for failure. A research hologram is analyzed and some measurements are given. A simplified mathematical model and extensive references are included. Author (TAB)

N67-16662*# Columbia Univ., New York.
ABSORPTION OF SOUND IN AIR VERSUS HUMIDITY AND TEMPERATURE
Cyril M. Harris Washington, NASA, Jan. 1967 241 p refs
(Contract NAS8-11002)
(NASA-CR-647) CFSTI: HC $3.00/MF $0.65 CSCL 20A

Measurements were made of the absorption of sound in air at third-octave frequency intervals from 2000 Hz to 12500 Hz, as a function of humidity, at six temperatures in the range from −0.5°C to 25.1°C at normal atmospheric pressure. The results of the new study are presented and compared with those of past studies, and a best fit is obtained to existing data. The resulting information is presented in both tabular and graphical form, and is useful for solving problems involving the calculation of attenuation of sound propagated in the atmosphere, and the computation of the effects of air absorption in problems of room acoustics. Results have been extrapolated downward in frequency to 125 Hz and extrapolated to cover the temperature range from −10°C to 30°C. Author

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N67-15386*# Maryland Univ., College Park.
THE $D_{3/2}$ NEUTRON SCATTERING RESONANCE IN THE SHELL MODEL OF O^{16}
L. Garside and W. M. MacDonald [1965] 5 p refs Presented at the Intern. Conf. on the Study of Nucl. Struct. with Neutrons, Antwerp, 19–23 Jul. 1965
(Grant NsG-642)
(NASA-CR-81154) CFSTI: HC $3.00/MF $0.65 CSCL 20H

A model Hamiltonian H_0 was derived for nucleon reaction amplitudes in the shell model approach to reaction theory. The model Hamiltonian H_0 used leads to the shell model of light nuclei and has both discrete and continuum A-particle states that are

simply constructed from the bound and continuum states of the central potential. Dispersion relations were used to calculate the reaction amplitude. A preliminary calculation based on this program was carried out by choosing a square well for the model central potential. The widths were calculated by derived wave functions, and the widths and energy shifts due to damping are presented in tabular form. The small energy dependence of the widths and resonance energies of all these states indicates that this is a satisfactory shell model description of all the resonances. It is pointed out that the model includes the very substantial configuration interaction with the $d_{3/2}$ state. L.E.W.

N67-15440*# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
BEAM EXCITATION OF RECTANGULAR AND SOC CAVITIES
K. B. Winterbon Jun. 1966 52 p refs
(FSD/ING-48; AECL-2613) CFSTI: HC $3.00/MF $0.65

Bunches of charged particles passing through SOC accelerating cavities induced fields in the cavities, which alter the velocities of subsequent particles. These fields, and the resulting velocity and position changes, called deflections for short, are calculated for an idealized rectangular cavity. Then expectation values of the deflections for real SOC cavities are estimated. We assume, somewhat pessimistically that these fields can not be allowed to change the energies of the particles by more than 3% of the mean energy gain of the particles per transit through a cavity. On this basis it is estimated that the probability of a given cavity in the second or third stage SOC of the ING proposal being unsuitable is not greater than 2%. Author

N67-15561 Israel Program for Scientific Translations, Ltd., Jerusalem.
NUCLEAR REACTIONS IN THE LOW AND INTERMEDIATE ENERGY RANGES
I. M. Frank, ed. 1966 787 p refs Transl. into ENGLISH of the book "Yadernye Reaktsii pri Malykh i Srednikh Energiyakh" Moscow, Izd. AN SSSR, 1962 Proc. of the 2d All-Union Conf. on Nucl. Reactions at Low and Intermediate Energies, Held in Moscow, 21–28 Jul. 1960 Published for AEC and NSF
(AEC-TR-6465) CFSTI: $3.00

Conference papers on few-nucleon systems, direct nuclear interactions, reactions induced by charged particles and neutrons, interaction of nuclei with heavy ions, photonuclear reactions, radiative capture reactions, and nuclear models are presented. For individual titles see N67-15562–N67-15658.

N67-15562 Israel Program for Scientific Translations, Ltd., Jerusalem.
FEW-NUCLEON SYSTEMS
N. A. Vlasov *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 1–11 refs (See N67-15561 06-24) CFSTI: $3.00

Elastic and inelastic collisions, as well as stationary and quasi-stationary states, are considered in connection with few-nucleon systems. Because of the weak coupling of systems, inelastic collision thresholds are quite low. Analysis of the continuous nucleon spectra from deuteron splitting on hydrogen and helium isotopes indicates that the shape of the spectra at small angles depends largely on pair interaction. The cross section for splitting of a 20 MeV deuteron in collisions with hydrogen and helium is like the cross section for elastic scattering. At a deuteron energy of about 20 MeV the intensity of the continuous spectrum neutron is several times that of the intensity of monoenergetic groups. Some results are presented for dineutrons, tetraneutrons, H^6, H^8, and heavier nuclei. M.W.R.

N67-15563 Israel Program for Scientific Translations, Ltd., Jerusalem.
SOME PROBLEMS OF THE THEORY OF LIGHT NUCLEI
A. I. Baz' *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 12–32 refs (See N67-15561 06-24) CFSTI: $3.00

A shell model is found to inapplicable on the nuclear surface, since the residual interaction between the nucleons becomes dominant rather than their self-consistent potential. Nucleon clusters should form on the nuclear surface, and the wave function describing the relative motion of the nucleon clusters beyond the nuclear surface is in the form of tails. The extension and amplitude of these tails, as well as the structure and width of the nuclear surface, vary greatly from level to level and from nucleus to nucleus. The nucleus spends most of its time in the form of a pair of particles moving in relation to each other. Nuclear single particle states with a large radius appear, as do considerable violations of the isotopic spin. Experimental data is presented that indicates the existence of nucleon clusters in the nucleus, and nonconservation of the isotopic spin is discussed. It is concluded that the nuclear surface has a relatively large number of levels with anomalously large widths that are located near the thresholds for the two-particle nuclear splitting. A simple model is used to investigate the influence of an attractive potential between the channel particles on the structure of the wave function. M.W.R.

N67-15564 Israel Program for Scientific Translations, Ltd., Jerusalem.
DEUTERON SPLITTING ON NUCLEI OF H, D, He^3 AND He^4
B. V. Rybakov, V. A. Sidorov, and N. A. Vlasov *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 33-38 refs (See N67-15561 06-24) CFSTI: $3.00

Spectra of neutrons formed in the interaction of deuterons with hydrogen and helium isotopes was studied with a multichannel spectrometer by the time of flight method that uses the natural modulation of the cyclotron beam. Gas targets, with pressures of 2 to 5 atm, having thin nickel windows were used. Spectra obtained in the center-of-mass system show that instrument width increases with energy. The high probability for the formation of nucleon pairs with low energy of relative motion is attributed to their attraction in the final state. The large apparent maximum width in the center-of-mass system of three nucleons is attributed to the superposition of the velocities of the mass center of the two nucleons on the velocity of their relative motion. The interaction of nucleons in the singlet state may lead to maxima in neutron spectra of deuteron reactions with more complex nuclei. Main features of the final state for the three-particle reaction are a shift toward higher neutron energies and neutron deficiency near zero energy. M.W.R.

N67-15565 Israel Program for Scientific Translations, Ltd., Jerusalem.
GROUND STATE OF A THREE-PARTICLE OR FOUR-PARTICLE SYSTEM
V. F. Turchin and Yu. V. Sokolov *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 39–45 refs (See N67-15561 06-24) CFSTI: $3.00

A quantum system is considered with a number of identical spinless particles of specified mass interacting through pair forces. Ground state of such a system is a singlet with total momentum equal to zero, and wave function of the system is invariant with respect to displacements and rotation of the vectors. Wave function should also be invariant with regard to a permutation of any pair of particles, and should vanish whenever any distance between two particles approaches infinity. The equation evolved for binding energy corresponds to an equation for spinless particles, since the number of triplet and singlet nucleon pairs in such

nuclei is the same. The presence of repulsion may lead to an effect that causes a decrease in the binding energy; and calculations given for the binding energies of tritium and alpha particles with and without repulsion indicate that the reduction occurs only in the singlet state. M.W.R.

N67-15566 Israel Program for Scientific Translations, Ltd., Jerusalem.
DIRECT PROCESSES
A. A. Ogloblin *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 46–60 refs (See N67-15561 06-24) CFSTI: $3.00

Spins and parities of nuclei as well as stripping and pick-up reactions are reviewed to obtain data on nuclear structure and the mechanism of direct processes. Pick-up reactions are considered the most convenient for the study of single particle states of nucleons inside the nucleus and of configurations of the ground states of nuclei; and details are presented of studies in these areas. Mention is made of excitation of collective states. Nucleon polarization in stripping reactions, the spin-flop phenomenon, and other direct reactions are treated. M.W.R.

N67-15567 Israel Program for Scientific Translatons, Ltd., Jerusalem.
DIRECT NUCLEAR REACTIONS. THEORY
V. G. Neudachin *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 61–77 refs (See N67-15561 06-24) CFSTI: $3.00

Problems characteristic of particle energies of less than 30 to 40 MeV are discussed, with emphasis on the stripping and other direct nuclear reactions. Reasons are given for the good description of the stripping reaction that results from a Born approximation. Stripping reaction, and various approximations for direct nuclear reactions are covered. In spite of successes in the qualitative understanding of direct processes and their role in nucleon-nucleus collisions, a more detailed development of the formalism is required to obtain quantitative results. The existence of a nucleon spectrum of statistical character is considered an indirect indication of the important role of long-lived states or the existence of separate resonances. The overlapping of resonances indicates a transition to cascade processes with each cut-off. M.W.R.

N67-15568 Israel Program for Scientific Translations, Ltd., Jerusalem.
The 3.51 AND 3.79 MeV LEVELS IN Si
C. Broude and H. E. Gove *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 78–82 (See N67-15561 06-24) CFSTI: $3.00

Techniques for the assignment of spins to nuclear states are applied to the 3.51 and 3.79 MeV levels of silicon 30. The levels are excited by inelastic proton scattering from a tandem accelerator, and the gamma correlations of the cascades of these levels are measured through the first excited state. Geometry and notations for the method are given, gamma ray curves for the reaction and both direct and coincidence spectra are shown, and measured and theoretical correlatons are tabulated. It is concluded that the 3.51 MeV state in silicon 30 is 2^+, and one of the two close levels at 3.79 MeV has a spin of zero. M.W.R.

N67-15569 Israel Program for Scientific Translations, Ltd., Jerusalem.
DISTORTED WAVE ANALYSIS OF THE $Si^{28}(d,p\gamma)Si^{29}$ REACTION DATA
D. A. Bromley, J. A. Kuehner, and E. Almqvist *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 83–88 refs (See N67-15561 06-24) CFSTI: $3.00

Proton-gamma correlation data for the $Si^{28}(d,p)Si^{29}$ reaction are analyzed in terms of a distorted wave formalism. A schematic representation of this direct reaction is shown, the matrix element and statistical tensors for the stripping amplitude are included, and the general form is given for the angular correlations predicted for the two cases under analysis. Typical angular correlations are measured with the protons detected on the stripping peak corresponding to formation of the 2.03 MeV $5/2^+$ state. The reaction tensors are considered as functions of the deuteron energy so that it is possible to predict the proton-gamma correlations as well as the magnitude of the polarization of protons detected at the stripping peak. Optical and shell model wave functions are then tested by substitution, and the correlation data is found to be well fitted on the assumption of a distorted wave direct interaction. Distortion effects decrease with increasing incident energy, and become quite small at 9 MeV. M.W.R.

N67-15570 Israel Program for Scientific Translations, Ltd., Jerusalem.
THE SPIN OF THE 4.97 MeV LEVEL IN Si^{28}
H.E. Gove and C. Broude *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 89–94 refs (See N67-15561 06-24) CFSTI: $3.00

A technique which permits a systematic identification of properties of the spin levels in nuclei of elements in the periodic table between oxygen and calcium is described, and experimental results are presented to show how the technique is applied to two levels of silicon 28. Except for the ground state and first excited state, none of the levels below 10 MeV in silicon 28 have spin assignments. A three-dimensional model of the coincidence correlation between the 3.20 and 1.78 gamma ray levels is shown; and a more conventional way of plotting these data indicates that both correlations are virtually identical. No evidence for a direct transition between the 4.97 MeV level and the ground state was observed, which is consistent with spin zero for the 4.97 state O–O gamma ray transitions are forbidden. The coincidence correlations of the two gamma rays from the cascade de-excitation of the 4.62 MeV level are virtually identical, indicating that the first radiation has the same multipolarity as the first and both are pure E2. M.W.R.

N67-15571 Israel Program for Scientific Translations, Ltd., Jerusalem.
STRIPPING REACTIONS OF α-PARTICLES FROM THE NUCLEI Be^9, C^{12} AND O^{16}
E. V. Inopin *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 95–96 ref (See N67-15561 06-24) CFSTI: $3.00

An alpha-particle stripping cross section is estimated from the nuclei Be^9, C^{12}, and O^{16}. It is assumed that all distances between alpha particles are fixed; and that the Be^9 nucleus has two alpha particles and a neutron, the C^{12} has three alpha particles lying at the apexes of an equilateral triangle, and the O^{16} has four alpha particles lying the apexes of a regular tetrahedron. The target nucleus is considered black with respect to the absorption of alpha particles, and the curvature of the nuclear boundary and Coulomb repulsion are neglected. Cross sections obtained for the stripping of alpha particles from a bombarding nucleus are considered to have semi-qualitative character since the model is rough. In the case of heavy nuclei, these cross sections are estimated by values of 0.5 to 1.0 barn. M.W.R.

N67-15572 Israel Program for Scientific Translations, Ltd., Jerusalem.
DIRECT PROCESSES AND EVAPORATION MECHANISM IN THE (N, P) and (N, D) REACTIONS ON LIGHT AND MEDIUM WEIGHT ELEMENTS AT NEUTRON ENERGY OF 14 MeV

L. Colli, I. Iori, G. Marcatizan, F. Mertzari, S. Micheletti et al *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 97–101 (See N67-15561 06-24) CFSTI: $3.00

Measurements of the spectra and angular distributions of the (n,p) and (n,d) reactions at a neutron energy of 14 MeV are presented. Deuteron spectra for Sc^{45}, V^{51}, Fe^{54}, Mn^{55}, Fe^{56}, Cr^{57}, Ni^{58}, Co^{59}, and Ni^{60} differ greatly from one another and display well-separated peaks. This indicates a direct process reaction, possibly by pick-up. Spectra of nuclei with an odd number of protons have very few deuterons with an energy corresponding to the formation of the ground state of the residual nucleus; and the contribution of deuterons of lower energy is relatively large. With an even number of protons, there is always a considerable contribution from deuterons of the maximum energy. The intensity of these peaks corresponds to the formation of the ground state and probably depends upon the number of neutrons; that is, the cross section of the peak decreases with an increasing number of neutrons. Many of the spectra show peaks at low deuteron energies, even corresponding to an excitation energy of the residual nuclei of several MeV; and this finding is considered related to the pick-up process. M.W.R.

N67-15573 Israel Program for Scientific Translations, Ltd., Jerusalem.

EXTRACTION OF REDUCED WIDTHS FROM THE STRIPPING REACTION OF THE DEUTERON

J. A. Kuehner, E. Almqvist, and D. A. Bromley *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 102–105 refs (See N67-15561 06-24) CFSTI: $3.00

None of the techniques for extracting reduced widths in deuteron stripping reactions appears to be superior with respect to capacity to give energy-independent values; since reduced width ratios obtained for both ground and 1.28 MeV states are very close, independently of the extraction method. Different methods do, however, lead to differences in absolute values; although good agreement was obtained between the usual method using the value of the cross section at the maximum and Bowcock's intensity method. Reduced width values are half the size when Amadeo's extrapolation method is used. M.W.R.

N67-15574 Israel Program for Scientific Translations, Ltd., Jerusalem.

DIRECT INTERACTION AND EFFECTS CONNECTED WITH THE FORMATION OF A COMPOUND NUCLEUS IN THE $Si^{28}(d,p)Si^{29}$ REACTION

J. A. Kuehner, E. Almqvist, and D. A. Bromley *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 106–109 (See N67-15561 06-24) CFSTI: $3.00

Energy dependence of the differential cross section of the reaction $Si^{28}(d,p)Si^{29}$ deuterons in the energy range of 6 to 10 MeV measured on a charge-exchange accelerator confirms the assumption that a direct interaction mechanism predominates. Cross section fluctuations are due to interference between the relatively small compound nucleus amplitude and the dominating direct interaction amplitude. Angular distribution and excitation curve measurements are reported from which a limit of less than 15% of the relative intensity of the compound nucleus formation is established with respect to the stripping process in the reaction leading to the ground state. M.W.R.

N67-15575# Israel Program for Scientific Translations, Ltd., Jerusalem.

EXCITED STATES OF O^{18} STUDIED BY THE $H^3(O^{16}, p\gamma)O^{18}$ REACTION

A. E. Litherland, R. Batchelor, A. J. Ferguson, and H. E. Gove *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 110–114 refs (See N67-15561 06-24) CFSTI: $3.00

Spins of 0 and 2 are reported for the 3.63 and 3.92 MeV states of oxygen 18. The low-lying structure thus far established resembles the vibrations state in heavy nuclei and has considerable string enhancement of E2 transitions. The primary 1.94 MeV gamma ray from the 3.92 MeV state exhibits an E2/M1 amplitude ratio of 0.1, which is 45 times greater than the ratio obtained from single particle estimates for which the radiating particle is assumed to be a neutron. The angular correlations of the cascade gamma rays are induced in both states by the $H^3(O^{16}, \text{proton-gamma})O^{18}$ reaction. Oxygen 16 was accelerated in a tandem accelerator and a target of tritium absorbed in zirconium was bombarded. M.W.R.

N67-15576 Israel Program for Scientific Translations, Ltd., Jerusalem.

POLARIZATION OF NEUTRONS IN THE $C^{12}(d,n)N^{13}$ REACTION

A. Budzanowski, K. Grotowski, Kh. Niewodnichanski, Ya. Nurzynski, and M. Stapa *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 115–116 ref (See N67-15561 06-24) CFSTI: $3.00

Polarization formed in the stripping reaction (d,n) on carbon was studied at angles of 15, 30, 45, and 60 deg and at an energy of 12.9 MeV of the incident deuterons; and analysis was made by means of elastic scattering of neutrons on helium nuclei. At the 15 and 30 deg angles, photographic plate measurements show that the number of neutrons corresponding to the second excited level of the nitrogen 13 nucleus is somewhat larger than obtained by measured polarization. M.W.R.

N67-15577 Israel Program for Scientific Translations, Ltd., Jerusalem.

ENERGY DEPENDENCE OF THE ANGULAR DISTRIBUTIONS OF PROTONS IN THE $B^{10}(d, p)B^{11}$ REACTION

S. V. Starodubtsev and B. I. Khrushchev *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 117–118 refs (See N67-15561 06-24) CFSTI: $3.00

Absolute cross sections and angular distributions for four long-range proton groups in the reaction $B^{10}(d,p)B^{11}$ were measured for energies of 5, 5.75, 6.5, and 7.25 MeV by thick layer photoemulsions in a multiple scattering chamber. It is assumed that both nucleons of the deuteron interact with the nucleus. Additional change in the spin of the product-nucleus, necessary for the conservation of parity and angular momentum, results from (1) spin-flop or (2) spin-flop with simultaneous change of angular momentum of the emitted proton. Strong shell effects cause deviation from the normal stripping process with regard to the transition to the first three excited states of B^{11}. M.W.R.

N67-15578 Israel Program for Scientific Translations, Ltd., Jerusalem.

(d,n) STRIPPING STUDIES ON B^{10} AND B^{11}

A. J. Ferguson, H. E. Gove, A. E. Litherland, and R. Batchelor *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 119–122 (See N67-15561 06-24) CFSTI: $3.00

A technique for the measurement of (d,n) stripping patterns is applied to targets of B^{10} and B^{11}. Angular correlation between the neutron and the gamma ray in the Born approximation is the product of the neutron stripping distribution and a function of the angle between the gamma ray direction and the recoil direction of the final nucleus. The gamma ray spectrum resulting from bombarding boron with deuterons contains rays from both the (d,n) and (d,p) reactions. The 6.5 MeV groups arise, at least in part, from two levels in C^{11} and 6.50 and 6.77 MeV excitation energy. Good discrimination is shown between this 6.5 MeV group and an 8.5 MeV; and results are included for other gamma ray ranges. M.W.R.

N67-15579 Israel Program for Scientific Translations, Ltd., Jerusalem.

COULOMB EFFECTS IN DIRECT INTERACTION

N. Hintz *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 123–126 refs (See N67-15561 06-24) CFSTI: $3.00

Experiments are discussed in which individual quantum states are not resolved in measuring the emitted particles, but the emitted proton or neutron carries away a large part of the energy of the incident particle. A semi-classical model is considered for processes with a small energy loss; and the nucleus is treated as a Fermi gas of noninteracting particles with a uniform momentum distribution up to the Fermi momentum; and nucleon-nucleon cross sections obtained agree within 20% with the experimental cross sections for two-body interactions. The contribution from the Coulomb interaction is independent of the Fermi energy for very low energies, although the Coulomb contribution becomes more important as the energy increases. For Cu^{63} the cross sections and ratios obtained are in good agreement with other data, although for Bi^{206} the cross sections are too large and the ratio is too small. Coulomb forces between the protons make considerable contribution to the direct interaction at high energies when the low-lying nuclear states are excited. M.W.R.

N67-15580 Israel Program for Scientific Translations, Ltd., Jerusalem.

THE (α,p) REACTION ON CARBON AND ALUMINUM AT α-PARTICLE ENERGIES OF 10 TO 15 MeV

T. V. Tsareva, A. M. Romanov, E. V. Myakinin, and M. P. Konstantinova *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 127–136 refs (See N67-15561 06-24) CFSTI: $3.00

Role of the direct interaction mechanisms in the $C^{12}(\alpha,p)N^{15}$ is investigated, along with the energy of strongly excited levels of Si^{30} and the role of the direct interaction mechanisms in the formation of Si^{30} in the ground and first excited states. Angular distributions of protons are considered for the carbon reaction in transitions to the ground state of Ni^{15}, and angular distributions and the Si levels excited in the reaction on aluminum are treated. The method used for the silicon excitation does not permit the reliable separation of the tracks of protons and deuterons; and the intensity of protons which are connected with the formation of low-lying levels of Si^{30} is found to be low. M.W.R.

N67-15581 Israel Program for Scientific Translations, Ltd., Jerusalem.

ANGULAR DISTRIBUTIONS OF α-PARTICLES IN (D, α) REACTIONS ON B^{10}, F^{19} AND Al^{27}

P. Cerineo *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 137–140 (See N67-15561 06-24) CFSTI: $3.00

Angular distributions and absolute differential cross sections of the $B^{10}(d,\alpha)Be^{8}$ were measured with the formation of the ground and first excited states of (1) Be^{8}, $F^{19}(d,\alpha)O^{17}$ and (2) $Al^{27}(d,\alpha)Mg^{25}$ for a deuteron energy of 13 MeV. Direct interaction, if not predominating is considered to play an important role in these reactions; and the pick-up process explains the mechanism of the (d,α) reactions on B^{10} and F^{19}. In the Al–Mg reaction it was impossible to separate the alpha-particles leading to the ground and excited levels of the Mg^{25}. M.W.R.

N67-15582 Israel Program for Scientific Translations, Ltd., Jerusalem.

ON THE UNIFIED THEORY OF NUCLEAR REACTIONS

Yu. V. Tsekhmistrenko *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 141–142 refs (see N67-15561 06-24) CFSTI: $3.00

A formalism is presented to obtain a mathematical description of the compound nucleus that completely agrees with Bohr's idea. There is no nonphysical concept of a channel radius. Since an exact expression for total amplitude of effective potentials is very complicated, equations are given for the effective cross sections near the isolated resonance. The total width does not include the partial width of potential scattering because the potential scattered wave is coherent with the incident one. The results can be generalized to include reactions with rearrangement of particles. M.W.R.

N67-15583 Israel Program for Scientific Translations, Ltd., Jerusalem.

REACTIONS INDUCED BY 14 MeV NEUTRONS

I. Shlaus *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 143–144 (See N67-15561 06-24) CFSTI: $3.00

Ground state reactions of $V^{51}(n,d)T^{50}$ and $O^{16}(n,\alpha)C^{13}$ were studied with 14 MeV neutrons. In one experiment, an effective crystal thickness of about 100 Mg/cm^2 was sufficient to completely stop the deuterons. The appreciable cross section maximum at an angle of 40 deg indicates the predominance of a direct reaction mechanism; and reduced width, calculated on the assumption of pick-up alone, is 0.026. For the oxygen reaction, the appreciable increase in black hemisphere cross section is considered indicative of a heavy stripping reaction. M.W.R.

N67-15584 Israel Program for Scientific Translations, Ltd., Jerusalem.

REACTIONS OF NUCLEONS WITH NUCLEI

P. E. Nemirovskii *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 145–152 refs (See N67-15561 06-24) CFSTI: $3.00

A two-stage theory is not always accurate to explain the reactions of nucleons with nuclei because a number of direct processes can proceed without the formation of a compound system. An optical model can be used to describe these direct processes, although the problem of the parameters of the model has not as yet been solved. Even in ideal experiments, it cannot be determined more accurately than to within 5 or 10% because the parameters are functions of energy and the theory itself is approximate in nature. Since the optical model can be used in some cases of decay processes in compound systems, some applications of the model are discussed in relation to radiative capture, inelastic scattering, and polarization. M.W.R.

N67-15585 Israel Program for Scientific Translations, Ltd., Jerusalem.

ELASTIC SCATTERING OF PROTONS BY ATOMIC NUCLEI

A. P. Klyucharev *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 153–158 refs (See N67-15561 06-24) CFSTI: $3.00

Targets of free thin metallic foils of enriched isotopes were prepared to study elastic scattering of protons on isotopes at several energies between 5.4 and 19.6 MeV. Because of the use of scintillation and nuclear photoemulsion, isolation and accurate measurements of the elastic proton groups were possible. Data presented for calcium, chromium, copper, nickel, zinc, and other isotopes show that all nuclei with an odd mass number and even nuclei loaded by neutrons have low thresholds. Nuclei of even mass number, but with a small difference between the number of neutrons and protons, usually have high thresholds. As energy increases, the contribution of proton scattering to the intensity of the process decreases because of the increasing probability of other inelastic decay channels of the compound nucleus; and the picture of elastic scattering approaches the diffraction picture. Isotopic effect of proton scattering, therefore, is less at high

energies than at low energies. Differences are observed in the value of the differential cross sections rather than in the behavior of angular dependence. M.W.R.

N67-15586 Israel Program for Scientific Translations, Ltd., Jerusalem.

MEASUREMENT OF INELASTIC COLLISION CROSS SECTIONS OF NEUTRONS WITH Fe, Ni, AND Nb NUCLEI AT NEUTRON ENERGIES FROM 0.6 TO 2.4 MeV

A. I. Abramov and M. G. Yutkin *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 159–166 refs (See N67-15561 06-24) CFSTI: $3.00

Two types of inelastic scattering processes were determined from the analysis of pulse spectra obtained by an inverse spherical geometry method. Inelastic scattering on all levels plus capture was found to decrease in the area under the spectral curve in the region of the primary neutron peak when a tritium target was mounted. Transmission with respect to inelastic scattering with excitation of a definite *i*-th level was also determined. Experimental results were found to be affected by only three factors: (1) the finite size of the chamber, (2) the finite distance between chamber and target, and (3) the anisotropy of the neutron source. Total cross sections are presented for iron, nickel, and niobium nuclei. M.W.R.

N67-15587 Israel Program for Scientific Translations, Ltd., Jerusalem.

ON SMALL ANGLE SCATTERING OF NEUTRONS

V. M. Agranovich and D. D. Odintsov *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 167–171 refs (See N67-15561 06-24) CFSTI: HC $3.00

Observations of Aleksandrov indicated that at angles of 3 to 5 deg there is disagreement between experimentally determined cross sections for fast neutron scattering and those calculated by taking the Schwinger interaction into considerations. Analysis indicates that this anomaly is not due to either the interaction of the neutrons with the K-electrons or with the Coulomb field of the nucleus. Additional experiments are necessary to attribute this observed anomaly to polarizability or to other reactions with respect to the field. Effects which make appreciable contributions to the scattering cross sections at small angles are discussed, including interference of the spin-orbit and Schwinger interactions, and interference between the elastic scattering of sufficiently slow neutrons by the atomic nucleus and electrons. M.W.R.

N67-15588 Israel Program for Scientific Translations, Ltd., Jerusalem.

RESEARCH FOR SIZE RESONANCES IN PROTON TOTAL REACTION CROSS SECTIONS

E. Almqvist, D. A. Bromley, J. A. Kuehner, and E. Vogt *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 172–176 refs (See N67-15561 06-24) CFSTI: $3.00

Energy dependence of the total absorption cross sections in the 4 to 12 MeV range were studied for a number of elements by using the variable energy facility of a tandem accelerator, and results were compared with those obtained by optical model calculations. Comparison of theory with experiment was restricted to seven elements in the Fe region of the atomic table. Titanium and iron show cross sections that rise smoothly over the entire energy range and reflect the second resonance peak above the top of the Coulomb barrier. Nickel and to some extent cobalt exhibit a flattening in the yield curves in the 7 to 8 MeV region, which is attributed to a close correspondence between second resonance and the top of the Coulomb barrier. The second resonance moved down below the barrier for Cu and Zn, and odd parity waves make the cross section rise more rapidly over the entire energy range. M.W.R.

N67-15589 Israel Program for Scientific Translations, Ltd., Jerusalem.

MEASUREMENT OF THE ABSORPTION CROSS SECTIONS OF FAST NEUTRONS BY MATTER

T. S. Belanova *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 177–184 refs (See N67-15561 06-24) CFSTI: $3.00

An experimental technique for the measurement of fast neutron cross sections eliminates the direct effect of the elastic scattering. The intensity of some neutron source is measured by a constant sensitivity detector; and this source is placed within the investigated material to measure the attenuation of the neutron flux. The decrease in neutron flux intensity permits the calculation of the neutron absorption cross section. The photo-neutron sources (Sb-Be, Na-D_2O, and Na-Be) were enclosed in spherical targets of Be or D_2O. Corrections were introduced because of (1) the finite distance between the detector and the neutron source, (2) neutron scattering in the walls of the containers used, (3) the fission of uranium 235 in the natural isotope mixture, (4) the fission of uranium 238 by neutrons from the Na-Be source, and (5) elastic and inelastic slowing down of neutrons in the spheres that modified the primary neutron spectrum. Absorption cross sections obtained for even-odd isotopes are considerably greater than those for even-even isotopes. M.W.R.

N67-15590 Israel Program for Scientific Translations, Ltd., Jerusalem.

(N, γ)-CORRELATIONS IN INELASTIC SCATTERING OF 14 MeV NEUTRONS ON C^{12} NUCLEI

B. A. Benetskii, Yu. P. Betin, V. A. Bukarev, and I. M. Frank *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 185–186 refs (See N67-15561 06-24) CFSTI: $3.00

Neutron yield was determined for inelastic scattering of protons on the carbon 13 nucleus; and the amplitude resolution of the neutron detector permitted the separation of neutrons with an energy of 7 MeV or higher with a threshold accuracy of 1 MeV. The detected gamma radiation was analyzed by a pulse height analyzer, and the scattering angle of the neutron was found to be 24 deg. The anisotropic part of the scattering is like the angular distribution observed when carbon 12 is irradiated with 14 MeV neutrons, and the emission angle of the inelastically scattered neutrons is not fixed. This is attributed to the small effective scattering angle of the neutrons. M.W.R.

N67-15591 Israel Program for Scientific Translations, Ltd., Jerusalem.

ANGULAR DISTRIBUTION OF PROTONS ELASTICALLY SCATTERED BY ISOTOPES OF CALCIUM, NICKEL, AND ZINC AT AN ENERGY OF 5.4 MeV

L. I. Bolotin, A. P. Klyucharev, N. Ya. Rutkevich, E. I. Revutskii, and B. I. Rudyak *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 187–191 refs (See N67-15561 06-24) CFSTI: $3.00

Angular distributions were studied for protons elastically scattered by even-even isotopes with large differences in number of neutrons, including Ca^{40} and Ca^{48}, Ni^{58} and Ni^{64}, and Zn^{64} and Zn^{68}. Proton scattering at 5.4 MeV was detected by photoplates placed in the scattering chamber at various angles to the incident between 20 and 160 deg. For all three elements, cross sections at 160 deg are smaller for the heavier isotopes than for the lighter isotopes. The anomalous behavior of scattering cross section at large angles for nuclei not overloaded by neutrons may be due to the large contribution of compound elastic scattering. Emission of a neutron from the compound nucleus is more probable than that of proton emission which has a potential barrier; although neutron emission is possible only at incident proton energies higher than the (p,n)-reaction threshold. For even isotopes threshold decreases with increasing number of neutrons. M.W.R.

N67-15592 Israel Program for Scientific Translations, Ltd., Jerusalem.

CALCULATION OF INELASTIC SCATTERING OF PROTONS BY THE DISTORTED-WAVE METHOD

D. C. Brown, L. Castillejo, and L. Goldfarb *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 192–193 (See N67-15561 06-24) CFSTI: $3.00

Nickel 58 was used to study the theory of direct interaction in inelastic scattering of protons of about 10 MeV that forms 2+ states. Differential scattering cross section and polarization are graphed for the protons, based on calculations for zero range nucleon-nucleon interactions and determined by a distorted-wave method. The incident proton excites not only the external neutron, but also the nucleons of the closed shell; and such excitations are paired in the usual way and increase transition probability. Vibrational levels thus result. M.W.R.

N67-15593 Israel Program for Scientific Translations, Ltd., Jerusalem.

EXCITATION OF THE 1.01 MeV LEVEL OF ANTIMONY NUCLEI IN INELASTIC SCATTERING OF NEUTRONS

D. L. Broder, A. I. Lashuk, and I. P. Sadokhin *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 194–197 refs (See N67-15561 06-24) CFSTI: $3.00

Annular geometry was used to obtain absolute yields of gamma rays appearing in elastic scattering of 0.84 MeV level iron; and the 1.01 MeV gamma rays from antimony were obtained by comparison with the cross sections of the iron. A curve of the relative gamma radiation detection efficiency was obtained for the NaI(T1) crystal used; and for this purpose gamma sources having cascade gamma-quanta were used. The appearance in the pulse-height spectrum of a gamma-line corresponding to 1.01 MeV gamma-quanta is observed when passing the neutron energy of 1 MeV, indicating that antimony nuclei have an energy level in this region that is excited in inelastic scattering of neutrons. For neutron energy exceeding 1.01 MeV, a line of about 0.9 MeV is also observed in the gamma-ray spectra; and it is assumed that the antimony nucleus has an energy level in the 0.9 MeV region, although it is not possible to attribute this level to a daifnite antimony isotope. Since the 1.01 MeV level is not assigned to a definite isotope either, the absolute cross sections are given for the natural isotopic mixture. M.W.R.

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OPTICAL MODEL CALCULATION OF THE DIFFERENTIAL CROSS SECTIONS FOR ELASTIC SCATTERING OF 6.8 MeV PROTONS ON NUCLEI OF SOME ISOTOPES OF NICKEL, COPPER, AND CHROMIUM

A. K. Val'ter, A. A. Vanetsian, A. P. Klyucharev, G. F. Timoshevskii, and G. D. Fedchenko *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 198–206 refs (See N67-15561 06-24) CFSTI: $3.00

Various values of optical model parameters were used to determine the elastic scattering differential cross sections of 6.8 MeV protons; and a least squares method was used to select the optimum parameters, or those which gave the best agreement between calculated angular distribution curves and experimental data for Cr^{53}, Cu^{63}, Cu^{65}, Ni^{58}, Ni^{60}, and Ni^{62}. Differential cross sections were calculated at 5 deg intervals in the 20 to 170 deg range, and influence of the five parameters is shown in curves for each of the isotopes. M.W.R.

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THE MECHANISM OF INELASTIC SCATTERING OF LOW-ENERGY PROTONS ON Al^{27}

S. S. Vasil'ev, E. A. Romanovskii, and G. F. Timushev *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 207–212 refs (See N67-15561 06-24) CFSTI: $3.00

Inelastic scattering of 6.6 MeV protons by Al^{27} nuclei was studied to clarify the role of direct interactions in the excitation of a large number of low-lying nuclear levels. During the collison of a 6.6 MeV proton with the Al^{27} nucleus, a compound nucleus of Si^{28} is formed; and a means for estimating the average distance between the compound nucleus levels is given. A magnetic analyzer with double focusing and a remote field meter is used to measure the angular distributions at 15 deg intervals in the 30 to 150 deg range for six proton groups. A comparison of the cross section values indicates that the asymmetry of the angular distributions is due to direct processes. Data obtained for the 6.6 MeV level agree well with total cross section data for the interaction of 10 MeV protons with Al^{27}, as well as with data obtained during the investigation of inelastic scattering of 5 MeV protons on Al^{27}. It is concluded, therefore, that direct interactions play an important role in the scattering of 5 to 7 MeV protons by Al^{27} nuclei. M.W.R.

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ELASTIC SCATTERING OF DEUTERONS ON GOLD AND SILVER

P. Gugelot, A. Dyie, U. Whitehead, and F. de Meer *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 213–214 refs (See N67-15561 06-24) CFSTI: $3.00

Since angular distributions for gold indicate that deviations from Rutherford scattering begin at a collision parameter approximately twice that of the nuclear radius, an attempt was made to measure these distributions where the deviations begin and the nuclear forces should be small. Deuterons with energies aroung 24.6 MeV were scattered on gold and silver targets; and deuteron energy was reduced to 22.0, 17.6, and 14.8 MeV by slowing down the incident beam in polyethylene foils. Accuracy of the absolute cross section was considered to be no more than 10%, but the relative variation of the cross section was determined within 4%. No definite bending pattern was observed in the angular distribution for silver in the energy range tested. The cross sections for gold, plotted as a function of the classical impact parameter, are almost equal at different energies. M.W.R.

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ELASTIC SCATTERING OF 400 KeV NEUTRONS ON Zn, Se, Zr, Nb, Mo, Cd, In, Sn

E. A. Koltypin and G. B. Yan'kov *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 215–218 refs (See N67-15561 06-24) CFSTI: $3.00

Angular distributions are measured for various neutron energies obtained by elastic scattering on Cd, In, Mo, Nb, Se, Sn, Zn, and Zr; and graphs of the expansion coefficients of the differential cross sections in Legendre polynomials are given as a function of the energy (about 400 KeV). Variation of the neutron angular distribution with increasing atomic weight agrees qualitatively with predictions of the optical model of the nucleus. For Cd, Mo, Se, Sn, Zn, and Zr there is a minimum cross section which increases slightly toward the 180° angle, but for In and Nb no such minimum is observed. A ground state spin is observed for In and Nb, whereas the main isotopes of the other elements have a spin equal to zero. The neutron angular distributions obtained in this study are slightly more isotropic than those reported elsewhere. M.W.R.

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NEUTRON SCATTERING AT SMALL ANGLES

V. M. Koprov and L. N. Usachev *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 219–225 refs (See N67-15561 06-24) CFSTI: $3.00

The anomalous pattern of scattering cross sections of neutrons at small angles on uranium and plutonium are not easily explained, and an analysis is presented of effects that might be implicated. If the Schwinger and polarization interactions are neglected, and the scattering amplitude is due only to the nuclear interaction. If the zero approximation is a wave function that accounts for nuclear scattering, and the Schwinger and polarization interactions are considered as perturbing potentials, then the first approximation of the perturbation theory leads to a total scattering amplitude composed of the nuclear, Schwinger, and polarization amplitudes. A calculation of Schwinger amplitude made on the basis of the optical model showed that the first 6 or 7 harmonics have no appreciable effect on the amplitude in the region of small angles. Using the Born amplitudes, an equation is then written for the total amplitude; and the detailed form of the scattering cross section and each of its five terms are considered. Only the linear part of the amplitude changes by improving the Born approximation. M.W.R.

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ELASTIC AND INELASTIC SCATTERING OF 14-MeV NEUTRONS FROM CARBON, MAGNESIUM, AND SULFUR

P. L. Clarke and W. G. Cross *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 226–231 refs (See N67-15561 06-24) CFSTI: $3.00

Inelastic angular distributions observed in C^{12}, Mg^{24}, and S^{32} indicate strong evidence for direct transitions to low-lying states; and in even-even nuclei these transitions show marked selectivity in picking out certain states, with preference for the first excited states. Apparatus used the measure the angular distributions of elastic and inelastic scattering from the three isotopes is shown, and various curves are plotted. Data indicate that spin, parity, and nuclear size are not the only important factors determining the features of direct interactions. M.W.R.

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(α,p)-REACTION IN MEDIUM WEIGHT ELEMENTS

N. O. Lassen and V. A. Sidorov *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 232–240 refs (See N67-15561 06-24) CFSTI: $3.00

Proton spectra formed by the bombardment by alpha-particles of some medium weight nuclei were investigated to determine the parameters used in statistical theory of nuclear reactions. Measurements were made with alpha-particles of full energy and of energies reduced by aluminum foils; and average energies of the alpha-particles in the target as determined by the ionization of the elastically scattered alpha-particles were 19.3, 17.8, 16.3, and 11.9 MeV. The 19.3 MeV may be underestimated by 2% because of a deviation from linearity. Proton spectra emitted at 90 deg from Cu^{63} bombarded by alpha particles are illustrated, and nuclear temperatures and cross sections are tabulated for Co^{59}, Cu^{63}, Cu^{65}, Ni^{58}, Ni^{60}, and V^{51}. M.W.R.

N67-15601 Israel Program for Scientific Translations, Ltd., Jerusalem.

AN ILLUSTRATION OF A SPECIAL TYPE OF TRIPLE CORRELATION MEASUREMENT WHICH CAN BE EASILY INTERPRETED

A. E. Litherland and G. J. McCallum *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 241–245 refs (See N67-15561 06-24) CFSTI: $3.00

A type of triple angular correlation measurement is described that is easily interrupted, and from which nuclear spectroscopic data can be obtained without any knowledge of the reaction mechanism itself. A special detector permits the angular correlation data to be interpreted independently of the details of the compound system. While correction for the size of the gamma-ray detector is purely a geometric one, the effect of the finite size of the neutron detector is more complex because contributions from higher magnitude substates appear in the correlations. These contributions, which depend upon the details of the compound state and can be determined by measuring the correlation with the neutron counter at different distances from the target, are shown to have little effect on the discussed method. The method is considered applicable to the study of nuclei of high excitations where the presence of overlapping levels in the compound nucleus makes for difficult interpretation by conventional methods. M.W.R.

N67-15602 Israel Program for Scientific Translations, Ltd., Jerusalem.

DETERMINATION OF E2/M1 AMPLITUDE MIXING RATIOS IN Al^{27} AND Si^{29}

G. J. McCallum *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 246–250 refs (See N67-15561 06-24) CFSTI: $3.00

Measurements of the angular distribution and linear polarization are described for determining the E2/M1 amplitude mixing ratios in Al^{27} and Si^{29}. A Compton polarimeter was used as the polarization detector, and the polarization of the gamma-quanta 3 emitted in a direction perpendicular to the incident beam 1 was measured. It is concluded that measurements that can be easily performed experimentally may become practicable at energies at which the levels of the compound nucleus overlap, or in cases when the energy of the incident particles is not accurately determined. M.W.R.

N67-15603 Israel Program for Scientific Translations, Ltd., Jerusalem.

SEARCH FOR A DOUBLE DIPOLE RADIATION IN THE C^{12} NUCLEUS

G. J. McCallum, D. A. Bromley, and J. A. Kuehner *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 251–254 refs (See N67-15561 06-24) CFSTI: $3.00

The possibility of simultaneous emission of two γ quanta with a fixed total energy occurring during the de-excitation of nuclear levels by electromagnetic radiation is considered. A formula for the probability of a double electric dipole transition is given, and the experimental search for double dipole radiation is described. The C^{12} level at 4.43 MeV was chosen because of the relatively high value of its branching ratio. A target of tantalum nitride, enriched by up to 60% N^{15}, was bombarded by 1.21 MeV protons accelerated in a Van de Graaf accelerator. The methods of measuring decay γ quanta, energy spectrum, pulse spectrum, and intensity of the direct γ quantum flux with an energy of 4.43 MeV are discussed. The ratio of the number of transitions by the emission of two dipole quanta to the number of electric quadrupole transitions was estimated after corrections were made for the effects of angular correlation, resolution time of the fast coincidence circuit, and for the fact that γ quanta with an energy higher than 600 keV were detected. L.E.W.

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NEUTRON GIANT RESONANCES—A NUCLEAR RAMSAUER EFFECT

J. M. Peterson *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 255–271 refs (See N67-15561 06-24) CFSTI: $3.00

The concept of a nuclear Ramsauer effect can be used to interpret neutron giant resonances as maxima created by interference between part of the neutron wave that has traversed

a partially transparent nucleus and the part of the wave that has gone around the nucleus. Families of resonances can be characterized by the relative wave shift between these two wave components. Widths of the resonances, of the same order as their spacings, are more related to the nuclear size and the real potential than to the imaginary potential. Neither the optical data nor the experimental data exhibit structure at energies much greater than the thresholds of inelastic scattering; and curves indicate that there is no structure in the inelastic cross section that corresponds to the very pronounced structure in the total cross section. An appendix discusses a proof that a resonance shifts to higher energy with increasing nuclear size for energies that are greater than the centrifugal barrier. M.W.R.

N67-15605 Israel Program for Scientific Translations, Ltd., Jerusalem.

ANOMALOUS BEHAVIOR OF THE Ca^{40} NUCLEUS IN INELASTIC SCATTERING OF 14 MeV NEUTRONS

V. I. Popov *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 272–273 refs (See N67-15561 06-24) CFSTI: $3.00

A spherical ionization chamber with a mixture of hydrogen and argon served as a spectrometer to study the neutron spectra arising in inelastic scattering of 14 MeV neutrons by several elements. Due to the wall effect in the chamber, measurements were considered sufficiently reliable only up to 4 MeV; and the presence of a small amount of helium in the chamber eliminated the contribution from elastically scattered neutrons. The spectrum of neutrons scattered by calcium 40 differs sharply from that for bismuth at 50° for an incident energy of 14 MeV; the calcium spectrum is characterized by a deep minimum at 1.5 MeV that cannot be explained by the usual evaporation model. M.W.R.

N67-15606 Israel Program for Scientific Translations, Ltd., Jerusalem.

SPECTRA OF SCATTERED NEUTRONS OF AN INITIAL ENERGY OF 3 MeV

V. I. Popov, O. A. Sal'nikov, and V. M. Sluchevskaya *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 274–278 refs (See N67-15561 06-24) CFSTI: $3.00

Data is reported on inelastic scattering of 3 MeV neutrons on bismuth, lead, silicon, and sodium in terms of applications to reactor engineering. Spectra are obtained at an angle of 60° and for the direct neutrons from the source emitted in the direction of the deuteron beam. The groups distinguished for bismuth correspond to the excitation of the known nuclear levels at 0.9 and 1.6 MeV. For lead the two isolated groups correspond to the intervals between 0.6 and 1.1 MeV and between 1.5 and 2.0 MeV of the nuclear excitation energy. The cross section at the 1.8 MeV level for silicon agrees with the total inelastic cross section for an energy of 3.1 MeV. The excitation curve of the 0.46 MeV sodium level in the neutron energy range from 2.45 to 4.00 MeV is drawn for sodium. M.W.R.

N67-15607 Israel Program for Scientific Translations, Ltd., Jerusalem.

INTERPRETATION OF INELASTIC SCATTERING OF 10.3 MeV DEUTERONS ON He^4

L. S. Sokolov and A. P. Mamontov *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 279–281 refs (See N67-15561 06-24) CFSTI: $3.00

An optical model is used to calculate the elastic scattering cross section as well as the reaction cross section of deuterons on He^4. Data indicate that the cross section break-up sharply increases with deuteron energy and with the atomic number of the target nucleus. Since the value for certain parameters for protons and neutrons is almost equal to that for deuterons, it is concluded that only one of the nucleons in the nucleus interacts with the deuteron. It is considered probable that the second nucleon will pass outside the range of nuclear forces. M.W.R.

N67-15608 Israel Program for Scientific Translations, Ltd., Jerusalem.

THE USE OF A RECTANGULAR COMPLEX POTENTIAL FOR DESCRIBING ELASTIC SCATTERING OF PROTONS WITH ENERGIES FROM 1 TO 40 MeV ON He^4

L. S. Sokolov and I. N. Lebkova *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 282–287 refs (See N67-15561 06-24) CFSTI: $3.00

A complex potential is used to describe the He^4 (p,p)-scattering for energies from 1 to 40 MeV in order to shed light on how potential parameters vary with energy. The equation for the potential is given; and the imaginary part of this potential is attributed to elastic scattering through the compound nucleus since there is neither inelastic scattering nor nuclear reaction taking place. The upper and lower limits for the model are 18 and 6 MeV; and, since the energy interval is small, it is difficult to draw any conclusions on the variation of potential parameters with energy. M.W.R.

N67-15609 Israel Program for Scientific Translations, Ltd., Jerusalem.

ELASTIC SCATTERING OF 13 MeV DEUTERONS ON SOME LIGHT ELEMENTS

L. Friendl, Y. Nurzinski, and A. Strazalkowski *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 288–291 (See N67-15561 06-24) CFSTI: $3.00

Angular distribution of elastically scattered 13 MeV deuterons on Al^{27}, Ca^{40}, C^{12}, and Mg^{24} was investigated in relation to nucleon polarization in stripping reactions and deuteron polarization in elastic scattering. Procedure employed is outlined; and graphs depict scattering of 13 MeV deuterons as well as deuteron scattering on aluminum. It is noted that for 15 MeV deuterons on aluminum, an increase in the differential cross section occurs for angles larger than 90 deg, but this increase is not as pronounced at 13 MeV. M.W.R.

N67-15610 Israel Program for Scientific Translations, Ltd., Jerusalem.

MOMENTUM DISTRIBUTION OF PROTONS IN LIGHT NUCLEI

H. Tyren and P. Isacson *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 282–295 refs (See N67-15561 06-24) CFSTI: $3.00

Recent investigations on quasi-elastic high energy proton-proton scattering on light nuclei are mentioned. The influence of the nuclear nucleons, with which there is no strong interaction, cannot be neglected even at the 450 MeV energy level; and this interaction can be taken into account by replacing the nucleus by a complex potential that distorts the front of the incident and outgoing waves. Decrease in cross section for quasi-elastic collisions is much larger for 200 MeV than for 400 MeV. Angular correlations of proton groups that can be separated with respect to binding energy is studied, and the energy spectrum for liquid helium is found to have a single well-isolated peak corresponding to a binding energy at 20 MeV. Triton is most often left in the ground state or near it. Angular correlation experiments made for some other light elements are in agreement with the general predictions of the shell model. The s-protons in lithium give a single peak, and the p-protons in lithium give two peaks in the angular correlation. M.W.R.

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STATISTICAL EMISSION OF NUCLEONS IN REACTIONS INDUCED BY 14 MeV NEUTRONS

U. Facchini, I. Iori, and E. Menichella *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 298–311 refs (See N67-15561 06-24) CFSTI: $3.00

The accuracy of an evaporation model is considered for use with the $\sigma(n,p)/\sigma(n,n)$ ratio for 14 MeV neutrons and for nuclei with atomic number from 10 to 40. Values of the parameters used in the model calculations were chosen, and the value for nuclear radius was adjusted. The model used can explain the large variations in the values of $\sigma(n,np)$ and $\sigma(n,2n)$ from nucleus to nucleus. Proton spectra in (n,p) and (p,p) reactions are discussed, as are cross sections of (n,p) reactions and (n,2n) and (n,np) reactions at 14 MeV. These experiments show the existence of some groups of reactions in which the emission of protons and neutrons by medium and light nuclei is governed by the law of equiprobability, which constitutes the Weisskopf evaporation model. The evaporation process is important for initial energies between 13 and 18 MeV; and in nuclei with large atomic number Z the emission of neutrons in the main process and occurs mainly by evaporation. The great variation in cross sections for (n,2n) and (n,np) reactions observed for medium nuclei can be adequately unified by this evaporation model. M.W.R.

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YIELD OF CHARGED PARTICLES AND TOTAL CROSS SECTIONS FOR 9.85 MeV PROTONS

N. Hintz and V. Meier *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 312–314 refs (See N67-15561 06-24) CFSTI: $3.00

An experiment to measure the energy and angular distribution of all the charged particles emitted by different nuclei in the 10 MeV region made use of an ordinary scattering chamber with scintillation CsI detectors. A tabulation of the cross sections obtained for the formation of charged particles indicates fluctuations dependent upon the Q value for the (p,n) reaction, and decrease for heavy elements. If the spectra are integrated over energy, disregarding protons inelastically scattered on the first excited state, then the angular distributions are isotropic. The reaction cross sections are then compared with the optical model. Recent calculations by the optical model indicate that sufficiently large reaction cross sections are obtained only if the imaginary part of the potential has a maximum on the nuclear surface and/or the radius of the imaginary part of the potential exceeds the radius of the real part. M.W.R.

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ANGULAR DISTRIBUTIONS AND CORRELATIONS IN THE REACTION $C^{12}(p, p'\gamma)C^{12}$ AT AN ENERGY OF 40 MeV

N. Hintz, H. Adams, and S. Chen *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 315–319 (See N67-15561 06-24) CFSTI: $3.00

The angular distribution of the inelastically scattered protons from the $C^{12}(p,p')$ nucleus reaction at the 4.43 MeV level, which was excited by means of 40 MeV protons, is graphically depicted and compared against theoretical results for the reaction according to the theory of surface interaction with plane waves. Experimental data are only in rough agreement with the plane wave models, probably due to the distortion of the incident and outgoing proton waves by the complex nuclear and Coulomb potentials. The data do agree however with values for the distorted waves calculated by a direct interaction approximation, up to angles $0 \geq 100°$. To obtain information on the coupling scheme for the wave function calculations of the C^{12} nucleus, and for verifying the direct interaction treatment, the angular correlation between the inelastically scattered proton and the γ-quantum emitted in the transition to the 4.43 level was measured, using a NaI crystal proton detector. Plotted data showing the dependence of the symmetry angle on the proton emission angle, and the dependence of the ratio A/B (where A and B are coefficients in the theoretical correlation expression) on the emission angle of the proton, are presented. Other angular measurement data are also presented and discussed. L.S.

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ELASTIC SCATTERING OF 6.8 Mev PROTONS ON Cr, Co, Ni, Cu AND Zn NUCLEI

Te-Ming Chou, Chan-Ling Mao, Jung-Fang Yun, Wen-Hsueth Liang, and Chung-Yao Chao *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 320–324 refs (See N67-15561 06-24) CFSTI: $3.00

The angular distributions of the 6.8 Mev protons scattered on Cr, Co, Ni, Cu, and Zn nuclei targets in a cyclotron accelerator proton beam focusing system were measured in the range from 20° to 165° at intervals of 5°, and the results are graphically depicted. A labelled diagram of the set-up is given. The elastic scattering angle was set with an accuracy of 1'. For small angles the curves for neighboring nuclei are similar. At angles of about 40° and 130° the curves pass through a maximum and at an angle of 80° through a minimum. The positions of the maxima and minima on the whole satisfy the relation: $\sin \theta_m/2 \alpha 1/kR = 1/kr_0A^{1/3}$ (where k is the wave number). The dependency of the scattering value on A is discussed; and comparisons of the data with similar experiments from the literature are made. L.S.

N67-15615 Israel Program for Scientific Translations, Ltd., Jerusalem.

INVESTIGATION OF THE COULOMB EXCITATION OF NUCLEAR LEVELS WITH THE HELP OF MULTIPLY CHARGED IONS

I. Kh. Lemberg *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 325–339 refs (See N67-15561 06-24) CFSTI: $3.00

The absolute values of Coulomb excitation cross sections of nuclear levels of a number of elements were measured by detecting the γ-quanta emitted by the excited levels. The Coulomb excitation of levels was achieved with the help of multiply ions accelerated in a cyclotron. The results of measurements for even-even nuclei where only the first levels with spin 2+ are excited with sufficient probability, and results of measurements with odd-A nuclei are presented in tables. The data illustrate how the range of light nuclei for which it became possible to obtain data on lifetimes by means of Coulomb excitation, was considerably extended by using multiply charged ions. In addition, tabulated information on the lifetimes of the first excited states of even-even isotopes is presented with results obtained from resonant scattering of γ-quanta, and from Coulomb excitation studies. Both categories of results are in good agreement within the limits of experimental errors. Theoretical estimates of B(E2) for the first excited levels for a number of nuclei with one of the shells (proton or neutron) closed are compared with the results of Coulomb excitation studies, and are in satisfactory agreement. L.S.

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COULOMB EXCITATION OF NUCLEI WITH A = 23–60 USING O^{16} IONS

H. E. Gove and C. Broude *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 340–346 (See N67-15561 06-24) CFSTI: $3.00

Gamma ray yields of the nuclei Na^{23}, Mg^{24}, Al^{27}, Si^{28}, V^{51}, Mn^{55}, Fe^{56}, Ni^{58}, and Ni^{60} resulting from Coulomb excitation using O^{16} bombardment, were measured in the 1d 2s shells. The Chalk River tandem accelerator used for accelerating the O^{16} ions is described and depicted in a schematic diagram. All measurements were made using thick targets and with a 12.5×15 cm unshielded NaI crystal set at 55° or 125° to the

beam direction. Plots of the gamma ray yields are given, and data concerning the bombardments are tabulated. The target element; the energy of the level excited; and the spins of the ground states and excited states respectively; the experimental values of the reduced transition probability for excitation; and recent values measured with heavy ions in other laboratories, are listed. The agreement is moderately good. Other details of the measured data are also discussed. L.S.

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NUCLEAR REACTIONS WITH HEAVY IONS

A. P. Klyucharev, N. Ya. Rutkevich, Yu. N. Ranyuk, L. I. Bolotin, Yu. F. Kulygin et al *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 347–351 refs (See N67-15561 06-24) CFSTI: $3.00

Details are given on the irradiation of nuclear photoemulsions by heavy ions. One hundred twelve C ions (and 84 MeV Be ions), accelerated in a linear accelerator, were analyzed in a magnetic field and, passing through a narrow diaphragm, fell on a photoplate at an angle of 25° to the photoemulsion surface. Stars caused by nuclear reaction were found in microscopic inspection of the irradiated photoplates. It was discovered that the Be stars were of one, two, three, and five rays; the number of rays in C ranged from one to seven. The star rays were then divided into three groups: formed by single-, double-, or multi-charged particles. As it was not possible to identify experimentally the particles emitted in the stars, results of the theory of evaporation of particles from the compound nucleus were used and the thresholds for various types of reactions were compared. The six-ray stars formed by double-charged particles were analyzed, and kinematic calculations indicated that they are formed by α particles produced in the disintegration of colliding C nuclei. L.E.W.

N67-15618# Israel Program for Scientific Translations, Ltd., Jerusalem.

COULOMB EXCITATION OF NUCLEAR STATES IN RARE EARTH ELEMENTS WITH 14–20 MeV α-PARTICLES

O. Nathan and V. I. Popov *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 352–354 refs (See N67-15561 06-24) CFSTI: $3.00

Gamma ray spectra with an energy up to 1.5 MeV were investigated from the Coulomb excitation of levels in rare earth elements. As incident particles 14 to 20 MeV α particles accelerated by a cyclotron were used. Gamma rays were detected by a NaI crystal in coincidence with the scattered α particles. In order to compute the radiative transition reduced probabilities data obtained for 17 MeV α particles were used. Tabulated data are given for results of those isotopes in which the corresponding gamma peaks could be resolved from other gamma lines, results obtained for high collective states in even–even isotopes in cases in which the gamma line observed could be ascribed to definite transitions, and results obtained for odd Z elements and for odd Sm isotopes. It was felt that the results indicated the existence of gamma vibrational states in certain odd nuclei, but the data were not sufficient to draw a definite conclusion about the nature of such states. L.E.W.

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SURVEY OF HEAVY ION RESEARCH IN THE UNITED STATES

A. Zucker *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 355–359 refs (See N67-15561 06-24) CFSTI: $3.00

The development and results of various experiments in heavy ion research are summarized, and the possibilities created by the development of linear accelerators are pointed out. The measurement of angular distributions of reaction products is discussed, and the investigation of the neutron transfer mechanism is reported. The use of high energy C, N, O, and Ne beams to study heavy-ion induced fission is described, and the important results obtained from this experiment are outlined. The exploration of elastic scattering at high energies is reviewed, and the investigation of multiple Coulomb excitation by high energy heavy ions is also covered. It was concluded that the outstanding advantages of heavy ions in the study of nuclear matter are (1) the validity of semiclassical approaches and (2) the large amounts of angular momenta in nuclear interactions, creating conditions that could not be produced in any other way. L.E.W.

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NUCLEAR REACTIONS AND SCATTERING WITH 28 MeV NITROGEN IONS

A. Zucker *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 360–368 refs (See N67-15561 06-24) CFSTI: $3.00

A detector, consisting of a single crystal of pure silicon onto which a thin layer of gold is evaporated, is described, and its performance and advantages are outlined. An experiment is discussed in which the counters were used in the measurement of the differential cross section of the inelastic scattering of nitrogen from the first excited state in C^{12}. The mechanism for inelastic scattering was also investigated, and it was stated that the scattering cannot be due to Coulomb excitation. A semiclassical theory of Ford and Wheeler is discussed in relation to examination of elastic scattering of nitrogen from light nuclei over large angular regions. N–Al scattering is given as an example in which the theory might be applied. Finally, continuing investigations of other nuclear reactions are briefly summarized. L.E.W.

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TWO PROTON RADIOACTIVITY

V. I. Gol'danskii *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 369–383 refs (See N67-15561 06-24) CFSTI: $3.00

Two-proton radioactive nuclei, ranging in atomic number from 4 to 50 related to this class on the basis of the values of nuclear masses are listed in a table which also contains the mass defects, proton-pair binding energies and proton pairing energies for these nuclei. Two-proton radioactivity is limited to the region of light nuclei up to tin (Z=50) because in heavier nuclei as the neutron deficiency increases, the α-instability arises first. Equations for the energy correlation of the two emitted protons from two-proton radioactive nuclei as a direct consequence of the tunnelling of the protons through the Coulomb potential barrier, are presented. The energy correlation is characterized by the predominance of such cases when the decay energy is equally divided between the protons. Equations for the angular correlation of the emitted protons are also given. In addition, theoretical calculations for the production of two-proton radioactive nuclei with Z=10–50 in reactions involving He^3 or multicharged ions are presented. Some remarks on three-particle nuclear fission, (two-proton radioactivity is a three-body problem) are included. L.S.

N67-15622 Israel Program for Scientific Translations, Ltd., Jerusalem.

RESONANT EFFECTS IN HEAVY ION INTERACTION MECHANISMS

D. A. Bromley, J. A. Kuehner, and E. Almqvist *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 384–394 refs (See N67-15561 06-24) CFSTI: $3.00

A series of measurements bearing on the energy and angular dependence of the elastic scattering cross sections of O^{16} and

C^{12} ions from several target elements for various ion energies in the energy range below 36 MeV are reviewed. A quasi-molecular interaction model which accords with the available data was postulated, and even more detailed measurements directed toward a determination of the low energy resonance parameters are presented. Excellent agreement with the Mott predictions was formed for both the energy and angular dependence of the cross sections at energies below the usual classically determined Coulomb barriers. At higher energies, the oxygen measurements show the usual exponential decrease of cross section with energy as fitted with the Blair model for nuclear absorption. In the carbon measurements on carbon and oxygen, marked resonance structure was found, particularly in the former case. This structure led to the postulation of a quasi-molecular potential for the C^{12} interactions which may be vitally dependent upon the deformability of the C^{12} nuclear as compared to O^{16} for example. Measurements are being made to fix the spin assignments to the lower energy quasi-molecular states. L.S.

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RESONANCES IN REACTIONS BETWEEN COMPLEX NUCLEI

E. Almqvist, D. A. Bromley, and J. A. Kuehner *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 395–403 refs (See N67-15561 06-24) CFSTI: $3.00

Studies for resonances in heavy ion reactions and new results of a study of the $C^{12}+C^{12}$ reaction are reported. These investigations were made possible due to the successful operation of the tandem accelerator which is capable of producing C^{12} and O^{16} ion beams of energies up to 35 MeV with an energy width of about 10 keV and an intensity of a few tenths of a microampere. Presented are yield curves of γ-rays emitted in bombarding targets of various elements by C^{12} and O^{16} ions; yield curves for various particles in the bombardment of C^{12} target by C^{12} ions; measured cross sections for reactions at 10 MeV in the center-of-mass system; yield curves of γ-quanta and α-particles in the $O^{16}+O^{16}$ reaction; spectrum and excitation curves of γ-radiation from a methane target bombarded by C^{12} ions; γ-radiation spectrum in the reaction $C^{12}+N^{14}$; and spectrum of γ-rays from the $C^{12}+C^{12}$ reaction at $E_C{}^{12}=12.2$ MeV. Previously reported measurements on relative yields of reaction products from the $N^{14}+C^{12}$ system were based on measurements of the activity of radioactive products; however, results of the present study constitute a new significant argument in favor of the deutron model of the N^{14} nucleus. Preliminary results of an investigation of the $O^{16}+Ne^{20}$ system indicate a similar mechanism for the stripped α-particle. It is surmised that such measurements may yield information concerning the amplitudes of complex quasi-particles at the nuclear surface. S.C.W.

N67-15624 Israel Program for Scientific Translations, Ltd., Jerusalem.

A "MOLECULE" FORMED BY TWO CARBON NUCLEI

E. Vogt and H. McManus *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 404–409 refs (See N67-15561 06-24) CFSTI: $3.00

Measurements carried out on the tandem accelerator in Chalk River have shown that C^{12}–C^{12} collisions exhibit sharp resonance structure in both reaction and elastic scattering cross sections. The properties of such levels are shown and from the background reactions proceeding through the compound nucleus it is concluded that the average states have C^{12} widths equal to about 0.01 of the single particle width, and total widths of about 150 keV. The magnitudes of the reaction cross sections are such that for the sharp resonances low angular momenta, smaller than or approximately equal to 6, must be involved. In elastic scattering states with high angular momenta are probably excited. It is proposed that states of the required spacing and width can be obtained if the resonance structure is attributed to molecular states in which both C^{12} nuclei retain their identities for appreciable periods with relative motion over large distances. Suggested is a model of such states which is intimately connected with the deformability of the C^{12} nucleus. The lack of structure in the $O^{16}+O^{16}$ reaction is attributed to the rigidity of O^{16}. Presented is an analysis of the interaction between two ions ($C^{12}+C^{12}$) on the basis of the analysis of α-particle scattering. The rigidity of the O^{16} nucleus not only narrowed to the molecular potential but also strongly decreased the formation probability for such states. S.C.W.

N67-15625 Israel Program for Scientific Translations, Ltd., Jerusalem.

PHOTONUCLEAR REACTIONS IN THE GIANT RESONANCE REGION

L. E. Lazareva *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 410–426 refs (See N67-15561 06-24) CFSTI: $3.00

A discussion of methodology used in studies of the fine structure and shape of the giant resonance is reported. The following new methods for studying the structure of the giant resonance are cited: the use of monochromatic γ-rays for studying in detail the cross sections in small energy intervals; the use of inverse reactions (p,γ) for studies of the giant resonance; and the use of a γ-detector of high resolving power for the direct measurement of the absorption cross section. Also cited are methodology for studies of the direct interaction of γ-quanta with nuclei, and methods for measuring cross sections for inelastic scattering of γ-rays by nuclei. S.C.W.

N67-15626 Israel Program for Scientific Translations, Ltd., Jerusalem.

REVIEW OF THEORETICAL WORK ON PHOTONUCLEAR REACTIONS

A. M. Baldin *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 427–438 refs (See N67-15561 06-24) CFSTI: $3.00

A review of theoretical studies on total absorption and scattering of photons by nuclei is reported. Cited are investigations of electric polarizability of atomic nuclei, the total absorption cross section, optical anisotropy of nuclei, and elastic photon scattering in the neighborhood of (γ,n)-reactions. S.C.W.

N67-15627 Israel Program for Scientific Translations, Ltd., Jerusalem.

ABSORPTION AND SCATTERING OF PHOTONS BY PROTONS OF DEFORMED NUCLEI

E. G. Fuller *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 439–455 refs (See N67-15561 06-24) CFSTI: $3.00

As summary of data presently available on the detailed shape of the giant resonance for those nuclei having large deformations is presented. Emphasized is the need for good resolution, high precision, activation curve data. Also included is a discussion of the scattering of photons by the giant resonance and the relationship of the scattering cross section to the total absorption cross section. S.C.W.

N67-15628 Israel Program for Scientific Translations, Ltd., Jerusalem.

RESIDUAL INTERACTION BETWEEN NUCLEONS IN THE NUCLEUS AND PHOTONUCLEAR REACTIONS IN THE GIANT RESONANCE REGION

V. V. Balashov, V. G. Shevchenko, and N. P. Yudin *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 456–461 refs (See N67-15561 06-24) CFSTI: $3.00

Consideration of the residual interaction among nucleons in the nucleus is shown to increase the nuclear excitation energy, which explains the energy position of the giant resonance maximum without resorting to the nucleon effective mass concept. The level excitation energy increase is determined by the diagonal part of the residual interaction. The nondiagonal part, responsible for configuration mixing, leads to a small increase of the dipole transition energy. The mixing of states due to the residual interaction opens additional channels for the decay of the quasi-stationary states arising in the gamma-quanta absorption. Due to the many resulting transitions, the low energy nucleon spectra display a statistical character. Consideration of the residual interaction reveals the microscopic nature of the decay through a compound nucleus. Determining the channel coupling by a detailed shell model calculation can justify the application of the complex potential in order to describe the giant resonance. The residual interaction's role in forming energy spectra of photonuclear reactions products will be essential in heavy nuclei in which the proton excitation levels disintegrate by the emission of neutrons. R.N.A.

N67-15629 Israel Program for Scientific Translations, Ltd., Jerusalem.
ROLE OF NUCLEON CLUSTERS IN DEEP PHOTODISINTEGRATION OF LIGHT NUCLEI
V. V. Balashov and Y. N. Fetisov *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 462–471 refs (See N67-15561 06-24) CFSTI: $3.00

An analysis of the reaction $C^{12}(\gamma, pt)2\alpha$ concluded that there are two possible manifestations of nucleon clusters in deep photodisintegration reactions in light nuclei. In the first, compound particles appear in the decay of the nuclear excited states arising in the absorption of a γ-quantum. These decays can be observed in the giant resonance region and at energies above the giant resonance. The decay probabilities of these states in transitions to different states of the residual nucleus can be calculated by the shell model. In the second possibility, there may be a peculiar quasi-alpha particle mechanism of γ-absorption at a γ-quantum energy of 60 to 70 MeV, leading to the simultaneous emission of a proton and a triton from the nucleus. R.N.A.

N67-15630 Israel Program for Scientific Translation, Ltd., Jerusalem.
ANGULAR AND ENERGY DISTRIBUTIONS OF RECOIL NUCLEI IN THE $Al^{27}(\gamma, 2pn)Na^{24}$ REACTION
V. A. Balitskii and F. P. Denisov *In its* Nucl. Reactions in the Low and Intermediate Energy Range 1966 p 472–480 (See N67-15561 06-24) refs CFSTI: $3.00

One of the most accurate methods of studying the mechanism of photonuclear reactions in the region of intermediate and high photon energies is the recoil nuclei method. The first investigations using this method on a number of complex photonuclear reactions showed that the average paths of recoil nuclei differ from those calculated on the basis of the evaporation model and the quasi-deutron model. It was proposed that the spatial and momentum structure of the nucleus plays an important role in complex photonuclear reactions in the energy region considered. As a direct continuation of these investigations, an experiment was performed on the FIAN synchrotron with an energy of 260 MeV, in which the differential angular and integral energetic distributions of recoil nuclei formed in the reaction $Al^{27} \rightarrow Na^{20}$ were measured. The measurements were made using special apparatus consisting of a casette containing the target, two collecting and two control films. The improved method and more precise calculations made it possible to otain new information on the reaction. R.N.A.

N67-15631 Israel Program for Scientific Translations, Ltd., Jerusalem.
GIANT RESONANCE REGION OF EXCITATION IN Ne^{20}
C. Broude and H. E. Gove *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 481–483 (See N67-15561 06-24) CFSTI: $3.00

THE Chalk River tandem accelerator was used to investigate the giant resonance region of excitation of nuclei by measurements on the capture gamma radiation following bombardment with protons of 4 to 11 MeV energy. The measurements described concern the radiative capture of protons by F^{19} giving information about the states of Ne^{20}. In addition, the yield of alpha particles to the ground state of O^{16} was measured as a function of bombarding energy. One might expect that the states which decay by alpha emission are not the same as those which are seen as resonances in the decay by gamma emission. However, the experimental results show some degree of correlation between the two modes of decay, lead to some speculation concerning the configuration of the highly excited states in Ne^{20}, and suggest some further measurements that could be made to establish whether this correspondence is genuine. R.N.A.

N67-15632# Israel Program for Scientific Translations, Ltd., Jerusalem.
INVESTIGATION OF THE GIANT RESONANCE IN THE NUCLEI C^{12}, Mg^{24} AND Si^{28} WITH THE HELP OF THE INVERSE (p, γ) REACTIONS
H. Gove, A. Litherland, and R. Batchelor *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 484–496 (See N67-15561 06-24) CFSTI: $3.00

Experiments are described in which the γ-quantum yield at 90° was measured following the capture of 11 MeV protons by the nuclei B^{11}, Na^{23}, and Al^{27}. In the case of B^{11} and Al^{27}, the radiation corresponding to the transitions to the ground and first excited states of the final nuclei C^{12} and Si^{28} was measured, while in the case of Na^{23}, the total γ-quantum yield corresponding to the formation of the ground and first excited states of Mg^{24} was measured. In addition, the angular distribution of these γ-quanta with respect to the incident proton beam was measured for certain proton energies. R.N.A.

N67-15633 Israel Program for Scientific Translations, Ltd., Jerusalem.
ANGULAR ENERGY DISTRIBUTIONS OF C^{11} NUCLEI IN THE $C^{12}(\gamma, n)C^{11}$ REACTION
F. P. Denisov, K. V. Kosareva, Yu. Ya. Tel'nov, and P. A. Cherenkov *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 497–501 refs (See N67-15561 06-24) CFSTI: $3.00

The energy and angular distributions of the recoil nuclei C^{11}, produced by irradiating carbon with bremsstrahlung of 260 MeV maximum energy using the FIAN synchrotron, were measured. The methods and experimental setup are described, and the results are shown graphically and discussed. R.N.A.

N67-15634 Israel Program for Scientific Translations, Ltd., Jerusalem.
DIRECT PHOTOEFFECT ON HEAVY NUCLEI FOR LOW EXCITATION ENERGIES
G. N. Zatsepina, V. V. Igonin, L. E. Lazareva, and A. I. Lepestkin *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 502–509 refs (See N67-15561 06-24) CFSTI: $3.00

A study was made of photoneutron angular and energy distributions for low excitation energies on heavy nuclei. Results obtained for bismuth and gold irradiated by bremsstrahlung with a maximum energy $E_{max} = 14$ MeV are presented. The research was performed on the FIAN synchrotron. Neutron energy spectra were measured at various angles to the direction of the X-ray beam. The neutrons were detected by recoil protons in nuclear emulsions. The (γ,n) and $(\gamma,2n)$ reaction thresholds for bismuth and gold are correspondingly equal to Bi–7.4 at 14.2 MeV and Au–8.0 at 14.0 MeV. Thus spectra of neutrons emitted as the result of the (γ,n) reaction were measured. R.N.A.

N67-15635 Israel Program for Scientific Translations, Ltd., Jerusalem.

THE MECHANISM OF γ-QUANTUM ABSORPTION BY P-SHELL NUCLEI

V. G. Neudachin, V. G. Shevchenko, and N. P. Yudin *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 510–518 refs (See N67-15561 06-24) CFSTI: $3.00

Rough calculations are made of E1 absorption cross sections of gamma quanta by Li^7, C^{12}, and C^{13} nuclei and the results obtained are compared with experimental data. The calculations are based on simplifying assumptions about the weak coupling of an s- and d-nucleon with p-core, and the four-grouping of nucleons in the p-shell (the Young scheme of the orbital part of the wave function is a good quantum number) which, apparently, are qualitatively justified. Author

N67-15636 Israel Program for Scientific Translations, Ltd., Jerusalem.

THE NATURE OF THE GIANT RESONANCE OF THE (γ,p) REACTION ON LEAD AND BISMUTH

V. G. Neudachin, V. G. Shevchenko, and N. P. Yudin *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 519–521 refs (See N67-15561 06-24) CFSTI: $3.00

The giant resonance of the (γ,p) reaction at $E_\gamma \approx 22$ MeV on Pb and Bi is shown to have a more complicated nature than usually assumed and is conditioned by the coincidence of two comparable maxima: (1) the giant resonance of gamma quantum quadrupole absorption, and (2) the dipole maximum of the (γ,p) reaction, which lies in Pb at an energy exceeding by 8 MeV the maximum of gamma quantum dipole absorption. Arguments for this viewpoint are given. The excitation energy spectra of protons and neutrons, and the energies of the important transitions for the nuclei Ca and Pb at the dipole absorption maximum are tabulated to illustrate the arguments. According to the arguments, the dipole and the quadrupole maxima in σ(γ,p) should move apart when going from Pb^{208} to the lighter nuclei, since the distance between the quadrupole maximum in σ(γ,p) and the dipole maximum in σ(γ,n) will increase, and the distance between the dipole maxima in σ(γ,p) and σ(γ,n) will decrease. The proton energy in the quadrupole maximum will be larger than in the dipole maximum, approximately by the energy separating these maxima. However, the quadrupole maximum measurement in nuclei with a small A will be difficult due to its large width. R.N.A.

N67-15637 Israel Program for Scientific Translations, Ltd., Jerusalem.

PHOTOPROTONS FROM Sn^{144} AND Sn^{124}

R. M. Osokina *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 522–527 refs (See N67-15561 06-24) CFSTI: $3.00

An investigation was conducted to determine whether the change in photoproton yields from different isotopes is accompanied by a change in the form of the spectrum of emitted particles and their angular distributions. The angular and energy distributions of photoprotons from Sn^{144} and Sn^{124} were studied. The photoproton yield from Sn^{144} is 5.8 ± 1 times greater than from Sn^{124}. The photoproton spectra from Sn^{144} and Sn^{124} differ considerably from each other. The latter has a maximum in the proton energy region 7 to 8 MeV, while the first has, in addition to this peak, a pronounced maximum in the proton energy region 5.0 to 6.5 MeV. The angular distribution of the low energy proton group in the photoproton spectrum from Sn^{124} is practically isotropic, while protons with energy above 7 MeV show a distribution close to $I(\theta) \approx \sin^2\theta$. The angular distribution of photoprotons from Sn^{114} with energies up to $\epsilon_p = 10$ MeV are isotropically distributed, while fast protons with ϵ_p greater than 10 MeV show some anistropy which increases with increasing proton energy. Results indicate that in Sn^{124}, transitions from p-shells play the main role, while in Sn^{114}, a large contribution comes from the transition $g_{9/2} \rightarrow f_{7/2}$ R.N.A.

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PHOTOPROTONS FROM Sb^{121} AND Sb^{123}

R. M. Osokina and V. G. Seryapin *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 528–531 refs (See N67-15561 06-24) CFSTI: $3.00

The angular and energy distributions of photoprotons from antimony samples enriched in the isotopes Sb^{121} and Sb^{123} were measured to determine the reaction (γ,p) on nuclei near the closed shell Z = 50. It was expected that the angular distributions and photoproton yields would greatly differ if the contribution of the valent protons was large. Proceeding from the known isotopic composition and measured proton yield, it was found that the photoproton yields from Sb^{121} and Sb^{123} for E_γ max = 19.5 MeV are related to each other as (1.2 ± 0.3):1. The angular and energy distributions of photoprotons from Sb^{121} and Sb^{123} are shown to differ from each other. However, it remains unclear to what extent this difference is determined by the valent protons. R.N.A.

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COMBINATION SCATTERING OF γ-QUANTA BY NUCLEI

B. A. Tulupov *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 532–533 refs (See N67-15561 06-24) CFSTI: $3.00

An attempt is made to show that the study of combination scattering of gamma rays by nuclei makes it possible to investigate the tensor polarizability of any nuclei. The tensor polarizability in the range of gamma quantum energies corresponding to the giant resonance is of the order of the scalar polarizability. Thus, it can be expected that at gamma quantum energies of 10 to 20 MeV, the cross section for combination scattering with the excitation of rotational levels will be of the same order of magnitude as the elastic photon scatter cross section at the same energy. This result is confirmed by recent experiments. R.N.A.

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RESONANCE SCATTERING OF BREMSSTRAHLUNG PHOTONS ON C, Mg, AND Si

A. Bussiere de Nercy and M. Langevin *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 534–538 refs (See N67-15561 06-24) CFSTI: $3.00

Resonance scattering of photons on carbon, magnesium, and silicon was studied with the help of a bremsstrahlung photon beam obtained on a betatron. The experimental setup excitation energy of the levels, the angular distribution of scattered photons, and absorption cross section are shown and discussed. R.N.A.

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RADIATIVE CAPTURE OF SLOW NEUTRONS

L. V. Groshev *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 539–549 refs (See N67-15561 06-24) CFSTI: $3.00

Considered are the regularities and special features of γ-ray spectra from the (n,γ) reaction. A magnetic Compton spectrometer was used in investigations of the reaction $Cd^{113}(n,\gamma)Cd^{114}$ for thermal neutrons. Reviewed and discussed in addition are several studies concerning γ-ray spectra accompanying thermal neutron capture, particularly of data obtained by means of magnetic spectrometers of high resolving power. Also mentioned is the development of new spectrometers in recent years. K.W.

N67-15642 Israel Program for Scientific Translations, Ltd., Jerusalem.

RADIATIVE PROTON CAPTURE AND SPECTROSCOPY OF LIGHT NUCLEI

S. P. Tystko *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 550–561 refs (See N67-15561 06-24) CFSTI: $3.00

Similarities, advantages, and disadvantages of (n,γ) and (p,γ) spectroscopy are initially compared, followed by a discussion of experimental possibilities and the methods of (p,γ) spectroscopy. A two-crystal γ-spectrometer, developed at the Institute for the study of cascade γ-transitions and $(\gamma-\gamma)$ correlations, is described. The spectrometer combines the properties of the integrating γ-spectrometer with those of the coincidence spectrometer; in conjunction with a multichannel pulse height analyzer it was used for studying γ-rays from proton radiative capture reactions. Presented are the final results of the reaction $Si^{30}(p,\gamma)$ and new information obtained on the levels of the P^{31}. K.W.

N67-15643 Israel Program for Scientific Translations, Ltd., Jerusalem.

DETAILED INVESTIGATION OF ENERGY LEVELS IN HEAVY NUCLEI WITH THE HELP OF NEUTRON CAPTURE γ-RADIATION

G. Bartholomew, P. Kempton, and J. Knowles *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 562–572 ref (See N67-15561 06-24) CFSTI: $3.00

Decay schemes were constructed from complicated spectra of neutron capture γ-rays in heavy nuclei using γ-spectrometers with very high resolution and accuracy. Whenever possible, the direct energy and intensity measurements were supplemented by $(\gamma-\gamma)$ coincidences and angular correlation measurements. Employed were a pair spectrometer with an energy resolution of 1% for energies above 3 MeV, and a flat crystal diffraction spectrometer with a resolution of 0.5% at 1 MeV for the energy region below 3 MeV. A device with two large NaI crystals was used to measure coincidences and angular correlations. The two neighboring isotopes Gd^{156} and Gd^{158} were investigated by these methods, since both Gd^{155} and Gd^{157} have large capture cross sections. As another example of capture γ-rays studies, the nucleus Nd^{144} was investigated by both irradiating a natural neodymium target and a neodymium target enriched in Nd^{143}. K.W.

N67-15644 Israel Program for Scientific Translations, Ltd., Jerusalem.

RADIATIVE PROPERTIES OF LOW LYING LEVELS IN Cd^{114}

L. V. Groshev, A. M. Demidov, V. N. Lutsenko, and V. I. Pelekhov *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 573–575 refs (See N67-15561 06-24) CFSTI: $3.00

The reaction $Cd^{113}(n,\gamma)Cd^{114}$ for thermal neutrons was investigated in relation to a vibrational model of spherical nuclei in which a two-phonon triplet with the quantum numbers 0^+, 2^+, and 4^+ is expected at twice the energy of the first excited level. The γ ray spectra and internal conversion electrons were measured, and the internal conversion coefficients and the multipolarities of the transitions derived from them are presented in tabular form. The probability for EO transitions $0^{+\prime}\rightarrow 0^+$ and $0^{+\prime\prime}\rightarrow 0^+$ were calculated and found to be 0.2 and 4 for the 1135 and 1305 keV transitions respectively. Although the first transition agrees with the predictions of the vibrational model, an unreasonable value was obtained for the 1305 keV level because the $0^{+\prime\prime}$ level is not a collective level as was assumed in the calculation. Thus, it was assumed that the 1135, 1207, and 1283 keV levels form the two-phonon triplet predicted by the vibrational model. The proposition that the $0^{+\prime}$ level at 1135 keV is caused by the excitation of a neutron pair is also considered. L.E.W.

N67-15645 Israel Program for Scientific Translations, Ltd., Jerusalem.

INVESTIGATION OF γ-RAYS FROM RESONANT NEUTRON CAPTURE BY HEAVY NUCLEI

K. G. Ignat'ev, I. V. Kirpichnikov, N. M. Kozodaeva, and S. I. Sukhoruchkin *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 576 (See N67-15561 06-24) CFSTI: $3.00

The spectra and angular correlations of γ rays emitted in neutron capture were investigated to resonance levels in tungsten, platinum, xenon, and silver. Because of the difficulties present in the interpretation of results using thermal neutrons, the energy separation in this study was obtained by the time-of-flight measurement on a multichannel selector with a pulsed cyclotron beam. Intensities of ground state transitions were compared and the angular correlation of cascade γ rays was measured, which permitted the determination of the spins of several resonance levels in the nuclei under investigation. It was shown that the intensities of ground state transitions from different levels strongly fluctuate from one level to another. L.E.W.

N67-15646 Israel Program for Scientific Translations, Ltd., Jerusalem.

RADIATION FROM THE (N, γ)-REACTION ON Cd, Pd, Os, AND Mo

V. V. Okorokov and V. D. Tolchenkov *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 577–587 refs (See N67-15561 06-24) CFSTI: $3.00

Characteristics of various levels are established by measurement of γ-ray spectra from nuclei excited as a result of resonant neutron capture to these levels. Reactions are investigated on cadmium, palladium, osmium, and molybdenum samples with a pulsed beam from a cyclotron serving as the neutron source. The experimental setup is shown schematically, and the nature of the measured spectra are considered for each of the four samples. S.P.

N67-15647 Israel Program for Scientific Translations, Ltd.,

MEASUREMENT OF RADIATIVE CAPTURE CROSS SECTIONS OF FAST NEUTRONS BY THE ISOTOPES $_{23}V^{51}$, $_{25}Mn^{55}$, $_{41}Nb^{93}$, $_{42}Mo^{100}$, $_{74}W^{186}$, $_{81}Tl^{205}$, $_{90}Th^{232}$

Yu. Ya. Stavisskii and V. A. Tolstikov *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 588–597 refs (See N67-15561 06-24) CFSTI: $3.00

The behavior of neutron radiative capture cross sections for specified isotopes was measured by comparison with the behavior of iodine, which was used as a standard sample. The method of measuring the β-activity induced in irradiation by fast neutrons was used, and a Van de Graff accelerator supplied the source of fast neutrons. Measurements of radiative capture cross sections are compared with previous results. The statistical model and the so-called "black nucleus" or optical model are discussed as the nuclear basis for calculation of the averaged cross sections. S.P.

N67-15648 Israel Program for Scientific Translations, Ltd., Jerusalem.

COLLECTIVE EXCITED STATES OF EVEN-EVEN ATOMIC NUCLEI

A. S. Davydov *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 598–606 refs (See N67-15561 06-24) CFSTI: $3.00

A nuclear model is applied to theoretical calculation of the energy states for systems composed of a large number of nucleons. Only excited states of nuclei whose equilibrium shape is nonspherical are considered. The belief in the existence of an axial symmetry axis in all nonspherical nuclei is shown to be

uncovincing. The theory that nuclear equilibrium may not be axially symmetric is presented. From this theory of rotational states of nonaxial nuclei, predictions in the adiabatic approximation are made of the relative intensities of E2-transitions between all the rotational states. Next the problem of monopole electric transitions (EO-transitions) between rotational states is examined. It is shown that electric monopole transitions between rotational states of nonaxial nuclei are possible, and that the theory of collective excited states in even-even nuclei is still in the initial stage of development. S.P.

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THE SHELL MODEL OF THE NUCLEUS

V. V. Balashov *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 607–619 refs (See N67-15561 06-24) CFSTI: $3.00

The place of the shell model among other nuclear models is evaluated, and problems of formalism and application of the shell model are presented. Application of the shell model in the region of heavy nuclei and the empirical relations derived from spectroscopic data verify the basic assumptions of the model about the order of filling the shells thus permitting more precise definition of the shell properties in nuclei. The basic properties of the shell structure of light nuclei are considered. The method of treating nucleon clusters within the framework of the shell model is discussed, and the shell model is also considered with respect to deformation of light nuclei. S.P.

N67-15650 Israel Program for Scientific Translations, Ltd., Jerusalem.

ON CERTAIN FEATURES OF THE STRUCTURE OF LIGHT NUCLEI

V. V. Balashov and A. F. Tulinov *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 620–625 refs (See N67-15561 06-24) CFSTI: $3.00

The Talmi method of calculating the levels of light nuclei in the (j–j) coupling model is reviewed, and the assumptions on which the method is based are given. Based on the same assumptions, an attempt was made to analyze quantitatively the competition between spin-orbit and two-body forces leading to the formation of intermediate coupling in nuclei of the p-shell. As an example, levels corresponding to $d_{5/2}$ excitations in the $p_{1/2}$ shell were considered. The following conclusions were drawn: (1) The (j–j) coupling scheme is generally suitable for describing the low levels of nuclei from C^{13} on. (2) Considerable deviation from the (j–j) coupling scheme occurs in states permitting four-clustering. (3) The main factor of intermediate coupling formation in light nuclei is the competition between spin-orbit interaction. (4) The calculation carried out helped to illuminate the problem of weak coupling of the external nucleon in light nuclei. L.E.W.

N67-15651 Israel Program for Scientific Translations, Ltd., Jerusalem.

MECHANISM OF VIBRATIONAL STATES

G. Brown *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 626–631 refs (See N67-15561 06-24) CFSTI: $3.00

Octupole vibrational states appearing in inelastic scattering and vibrational states of the type 2^+, found in nuclei with partially filled shells, are considered, and an attempt was made to show that these vibrational states result from the mixing of shell excitations by the mechanism of particle hole interaction. Consideration is given to dipole vibrations with T=1 and octupole vibrations with T=0 in spherical nuclei, e.g., O^{16} and Ca^{40}. Odd excited states were stated to arise from the transition of a particle from a filled shell into the next shell, leaving behind a hole. States with T=1 and T=0 involve different linear combinations of proton and neutron excitations. It was pointed out that the methods employed can also be used in the case of nuclei with unfilled shells after passing to the quasiparticle picture. Although only a few possibilities of vibrational states have been studied in this paper, it is emphasized that the mechanism indicates other, still unobserved vibrational states. L.E.W.

N67-15652 Israel Program for Scientific Translations, Ltd., Jerusalem.

COLLECTIVE MAGNETIC G-FACTORS OF ROTATIONAL LEVELS

F. Villars and Ya. I. Yangu *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 632–633 refs (See N67-15561 06-24) CFSTI: $3.00

The method of Yoccoz–Peierls, which is based on the assumption that for any nucleus with an established rotational spectrum there is the Schroedinger equation

$$H\Psi_{njkm} = [E_{nK} + K_0(J(J+1) - K^2)]\Psi_{njkm},$$

was applied to the calculation of the collective (core) g-factors of rotational states. A wave packet is constructed, which represents a stationary nucleus. Estimates were made of g_R for even nuclei of the rare earth elements assuming independent particles and taking into account pairing forces. Preliminary results are presented in tabular form. L.E.W.

N67-15653 Israel Program for Scientific Translations, Ltd., Jerusalem.

THE INERTIAL PARAMETER B OF NUCLEAR QUADRUPOLE OSCILLATIONS

F. Villars *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 634–636 (See N67-15561 06-24) CFSTI: $3.00

It is shown how the Inglis formula for the inertial parameter of collective oscillations may be derived without using the concept of a time-dependent self-consistent potential well. The approach used is based on the method of coordinate transformations, which defines five quadrupole amplitudes and their conjugate momenta in terms of the original particle coordinates and momenta. The intrinsic dynamics are expressed by a set of pseudo-coordinates and momenta, which are functions of a set of independent variable pairs. The results were compared with the approach based on a time-dependent Hartree–Fock procedure, and two differences were discovered, which lead to the establishment of the Inglis formula outside the framework of a time-dependent Hartree–Fock procedure. L.E.W.

N67-15654 Israel Program for Scientific Translations, Ltd., Jerusalem.

SHELL EFFECTS IN ELECTROMAGNETIC TRANSITION PROBABILITIES IN THE REGION N=82

E. E. Berlovich, V. N. Klement'ev, and L. V. Krasnov *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 637–641 refs (See N67-15561 06-24) CFSTI: $3.00

The essential features of the pattern of the distribution of matrix elements for radiative transitions of various types and polarities are given as a function of the number of nucleons in the nucleus. Data was obtained on the dependence of matrix elements on the number of neutrons in the region of the shell N=82 for transitions of the types M2 and E3 by investigating the transitions of the spherical nuclei of europium with odd mass numbers Eu^{147}, Eu^{149}, and Eu^{151}. It was shown that the levels of these europium nuclei with energies 625, 496, and 167 keV respectively are actually isomeric, and the lifetimes of these levels were measured. The techniques used in measuring the lifetime are described, and the results are tabulated. The values obtained for the logarithms of the comparative lifetimes are plotted. All the M2 transitions

proved to be delayed on the average by two orders of magnitude as compared with single particle estimates, and the delay increases monotonically as the number of neutrons increases from 84 in Eu^{147} to 88 in Eu^{151}. L.E.W.

N67-15655 Israel Program for Scientific Translations, Ltd., Jerusalem.
SOME FEATURES OF THE NUCLEAR ENERGY SURFACES
V. A. Kravtsov *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 642–656 refs (See N67-15561 06-24) CFSTI: $3.00

Previous experiments and theory of nuclear energy surfaces are reviewed, and the influence of nuclear shells on various characteristics are considered. Some of the conclusions reached include: (1) The effect of shells gives rise to ditches on the energy surfaces. (2) The jump in the slope of the ditch banks at its bottom or the ditch depth can be used to measure the strength of a nuclear shell. (3) The largest strength of neutron shells is somewhat greater than that of proton shells. (4) The distance between the even–even and the even–odd energy surfaces exceeds the distance between the odd–even and the odd–odd surfaces. (5) The distance between the surfaces D decreases with increasing mass number slower than assumed in the semi-empirical mass formula. (6) An increase occurs in the distances D between the surfaces near magic nucleon numbers and at the boundaries of regions of deformed nuclei. (7) The increase in the distances between the surfaces for nuclei near the neutron and proton magic numbers equal to 40 is too large for this semimagic number. L.E.W.

N67-15656 Israel Program for Scientific Translations, Ltd., Jerusalem.
TALMI TRANSFORMATION FOR PARTICLES WITH DIFFERENT MASSES
Yu. F. Smirnov *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 657–666 refs (See N67-15561 06-24) CFSTI: $3.00

The Talmi coefficients used to perform the transition to the center-of-mass system of two particles with identical masses in the oscillator potential are given, and the Talmi coefficients are defined. A more general Hamiltonian is considered for application to the case of particles with different masses, and the eigenvalues are presented. The Talmi coefficients are derived from these functions for particles with different masses, and form a unitary matrix. A general formula is then derived for the Talmi coefficients, and a proof is given of the unitarity of the Talmi transformation. L.E.W.

N67-15657 Israel Program for Scientific Translations, Ltd., Jerusalem.
CALCULATION OF REDUCED WIDTHS FOR NUCLEON CLUSTERS
Yu. F. Smirnov and D. Khlebovska *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 667–676 refs (See N67-15561 06-24) CFSTI: $3.00

A general formula is derived for the reduced width for the emission of a cluster of m nucleons (n = 1,2,3,4) from a nucleus with atomic number A, and results are compared to a previously proposed method. Methods are given of determining the fractional parentage coefficients, the factor $K_m(N\Lambda,L_3)$ and, for more complex configurations, modification of the correction for the general center-of-mass. The reduced widths of several nuclear levels of p-shell nuclei are results of the calculations show good agreement with the previously proposed method for calculating reduced widths for nucleon clusters in the framework of the shell model for a number of levels in light nuclei. Applications of the method are briefly considered. L.E.W.

N67-15658 Israel Program for Scientific Translations, Ltd., Jerusalem.
COLLECTIVE PROPERTIES OF D-SHELL NUCLEI
V. G. Sukharevskii *In its* Nucl. Reactions in the Low and Intermediate Energy Ranges 1966 p 677–684 refs (See N67-15561 06-24) CFSTI: $3.00

The collective properties of d-shell nuclei were investigated by analyzing reduced widths from deutron stripping reactions. Consideration is given to even–even nuclei, odd–odd nuclei, and nuclei with odd a. The following conclusions were drawn: (1) Reduced widths from stripping reactions may be successfully applied to the analysis of nuclear structure. (2) The collective properties of d-shell nuclei change from S^{20}; the energy of the first excited state 2^+ IN EVEN–EVEN NUCLEI ceases to satisfy the Bohr–Mottelson criterion for rotational states, and the shape of the nuclei changes from prolate to oblate (the deformation parameter becomes negative). (3) The weak coupling scheme of the external nucleons to the nuclear core is realized in the even–even and odd–odd nuclei investigated. L.E.W.

N67-15686*# Lockheed Missiles and Space Co., Palo Alto, Calif. Research Lab.
SPECTRAL ABSORPTION COEFFICIENTS OF CARBON, NITROGEN, AND OXYGEN ATOMS
K. H. Wilson and W. E. Nicolet Nov. 1966 86 p refs
(Contract NAS2-3496)
(NASA-CR-73049; LMSC-4-17-66-5) CFSTI: HC $3.00/MF $0.65
CSCL 20H

The spectral absorption coefficients of neutral and singly ionized atoms are presented. The continuum contributions resulting from bound-free and free-free transitions are presented in terms of an effective cross section summed over all permissible initial and final states. The effective continuum cross sections are tabulated spectrally over a frequency range 0.25 eV $\leq h\nu \leq$ 20 eV for temperatures in the range 3,000°K to 24,000°K at 1,000°K intervals. The discrete, i.e., line, contributions resulting from bound-bound transitions are presented in terms of tabulations of absorption f-numbers for all significant transitions (multiplet, supermultiplet, and transition arrays). Electron impact (half) half-widths and line shifts for Lorentzian line shapes are tabulated for all significant transitions for temperatures in the range 2,500°K to 25,000°K. Author

N67-15735*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE INTERACTION OF A NONPOLAR ATOM OR MOLECULE WITH AN INHOMOGENEOUS SURFACE ELECTRIC FIELD
D. P. Merrified and J. King, Jr. *In* its Space Programs Sum. No. 37–41, Vol. IV 31 Oct. 1966 p 174–177 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

A mathematical discussion is presented on the electrostatic interaction of a nonpolar atom or molecule with an inhomogeneous surface electric field. A Hamiltonian equation is derived for perturbation by the electric field, and the first- and second-order perturbations to the ground-state energy are expressed. In a series of equations for matrix elements expressed in terms of atomic orbitals, the approximate form for the second-order contribution to the interaction energy is derived. The potential over the atomic orbitals for helium is treated, and the extension of these calculations to other closed-shell atoms and molecules (with the same approximations) is also mentioned. R.U.

N67-15736*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
NEW EXPRESSIONS FOR THE ENERGY DENSITY AND MOMENTUM FLUX OF AN ELECTROMAGNETIC FIELD
M. M. Saffren *In its* Space Programs Sum. No. 37–41, Vol. IV 31 Oct. 1966 p 177–179 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

To express the photon momentum flux at a point in space in terms of current—current correlations in the source emitting the radiation, new expressions are derived for the energy density and momentum flux of an electromagnetic field. Theorems are reviewed to express the components of the photon stress energy as a function of photon and electron variables. Equations are also derived for the photon momentum flux and the photon energy density. R.LI.

N67-15742*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FOUR-FERMION INTERACTION LAGRANGIANS
J. S. Zmuidzinas *In its* Space Programs Sum. No. 37–41, Vol. IV 31 Oct. 1966 p 192–195 refs (See N67-15701 06-11) CFSTI: HC$3.00/MF$0.65

The combination of the Pauli exclusion principle and the Fierz rearrangement theorem are shown to limit the arbitrariness of a Lorentz invariant interaction Lagrangian (density) L_1 for a self-coupled Dirac field. Considerations are limited to quartic Lagrangians and to gradient-free and local expressions for L_1. The chiral transformation properties of L_1 are briefly discussed and it is noted that in this form L_1 is Fierz-invariant. A.G.O.

N67-15767# Aktiebolaget Atomenergi, Stockholm (Sweden).
ABSOLUTE TRANSITION PROBABILITIES FROM THE 453.1 KeV LEVEL IN 183 W
Sven G. Malmskog Oct. 1966 14 p refs Submitted for Publication
(AE-251) CFSTI: HC$3.00/MF$0.65

The half life of the 453.1 keV level in 183W has been measured by the delayed coincidence method to 18.4 ±0.5 nsec. This determines twelve absolute M1 and E2 transition probabilities, out of which nine are K-forbidden. All transition probabilities are compared with the single particle estimate. The three K-allowed E2, $|\Delta K| = 2$ transition rates to the 1/2−(510) rotational band are furthermore compared with the Nilsson model. An attempt to give a quantitative explanation of the observed transition rates has been made by including the effects from admixtures into the single particle wave functions. Author

N67-15810*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ON ROSTOKER'S TEST PARTICLE THEOREM
C.-S. Wu *In its* Space Programs Sum. No. 37–40, Vol. 4 31 Aug. 1966 p 134–136 (See N67-15781 06-34) CFSTI: HC $3.00/MF$0.65

It is shown that Rostoker's theorem can be generalized to include a radiation field as well as an applied magnetic field in the Klimontovich formalism. A homogeneous multispecies plasma is considered, and the mathematical discussion is based on time-asymptotic function and Fourier transform. N.E.N.

N67-15811*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
REACTION OF O(^{1}D) WITH HYDROGEN. PART II: THE UNSCAVENGED CASE
W. B. de More *In its* Space Programs Sum. No. 37–40, Vol. 4 31 Aug. 1966 p 137–141 refs (See N67-15781 06-34) CFSTI: HC$3.00/MF$0.65

The experiments to determine the nature of the observed chain and the identity of the chain carriers is described for the case of the H atoms not scavanged by O_2 reacting with O_3. The water yield was found to decrease with increasing chain contribution, and it was concluded that the chain stoichiometry is $O_3 \rightarrow 3/2\ O_2$. Results further indicate chain propagation by the reaction $H+O_3 \rightarrow OH+O_2$, with $\Delta H = -77$ kcal/mole, and chain termination by $H+O_2+M \rightarrow HO_2+M$. The chain propagation reaction set, $OH+O_3 \rightarrow H+2O_2$ and $H+O_3 \rightarrow OH+O_2$, was considered to be consistent with all experimental observations. A discussion of these results is included. N.E.N.

N67-15950*# California Univ., Berkeley. Lawrence Radiation Lab.
FLUCTUATIONS OF ENERGY LOSS BY HEAVY CHARGED PARTICLES IN THIN ABSORBERS
Howard D. Maccabee, Mudundi R. Raju, and Cornelius A. Tobias *In its* [Studies of Heavily Ionizing Particles and Space Biol.] 1966 p 82–86 refs (See N67-15941 06-04) CFSTI: HC $3.00/MF$0.65

An experiment is described which was designed to verify the theory that the total energy loss distribution in thin absorbers has normal Gaussian shape. Both 730 MeV protons and 910 MeV alpha particles from a synchrocyclotron were passed through lithium-drifted silicon semiconductory detectors, and typical results are graphed. Agreement between energy loss distributions and theory was regarded to be good when room temperature effects were considered. N.E.N.

N67-16091*# Bell and Howell Research Center, Pasadena, Calif.
A STUDY OF THE INTRODUCTION OF IONS INTO THE REGION OF STRONG FIELDS WITH A QUADRUPOLE MASS SPECTROMETER Fifth Quarterly Progress Report, 17 Aug.–17 Nov. 1966
Wilson M. Brubaker 17 Nov. 1966 46 p
(Contract NASw-1298)
(NASA-CR-81260) CSCL 20G

This project is a theoretical and experimental study of the introducton of ions into the strong fields of a quadrupole mass filter. The performance of a conventional quadrupole has been compared to that of one with a lower ratio of dc to ac fields in the entrance region for a wider range of ion injection energies. The superior performance of the delayed dc mode of operation is well documented. Computations have been of the trajectories as the ions leave the quadrupole field. These show that the termination of the field should be as abrupt as possible, or a delayed ac ramp used to prevent large radial accelerations of the ions. A system for making careful comparisons of the performance of quadrupoles with round and hyperbolic rod structures has been assembled and put into operation. Author

N67-16096# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MODELING OF PARTICLE MOVEMENT IN OVERLAPPING ELECTRICAL AND MAGNETIC FIELDS
N. V. Trikhanova and P. M. Shchanin *In its* News of Inst. of Higher Learning. Phys. 18 Apr. 1966 p 1–6 refs (See N67-16095 06-23) CFSTI: HC $3.00/MF $0.65

Equations are developed for particle trajectories in overlapping magnetic and electric fields, with various initial conditions. An electron modeling installation was used, and a description and structural block diagram of the model are presented. Tolerances for stability of electric field and the energies of particles are also reported. N.E.N.

N67-16110# Stanford Univ., Calif. High Energy Physics Lab.
EXCITATION OF ^{31}P AND ^{32}S BY 180° ELECTRON SCATTERING
P. Kossanyi-Demay and G. J. Vanpraet Aug. 1966 23 p refs Submitted for Publication
(Contract Nonr-225(67))
(HEPL-394, Rev.; AD-641115) CFSTI: HC$3.00/MF$0.65

Measurement was made of the differential cross sections for inelastic scattering of 50 MeV electrons at 180 deg. by 31P and 32S nuclei. Using the long wave length approximation, lower limits for radiation widths were derived for the levels. For 32S the giant dipole resonance was investigated, and the results are compared with a recent calculation of B. M. Spicer. Author (TAB)

N67-16180# Naval Ordnance Lab., White Oak, Md.
COMPLEX RELATIVITY THEORY AND WAVE MECHANICS, (Ia)
Andre Gleyzal 30 Sep. 1966 47 p refs
(NOLTR-66-189; M-67; AD-641908) CFSTI: HC $3.00/MF $0.65

This paper endeavors to show that a mathematically defined complex gravitational world represents the physical world and provides a unified field theory of relativity. The motion and the de Broglie wave psi of a complex particle M = m + ie/square root of gamma in a world W(M sub o), where M sub o = m sub o + ie sub o/square root of gamma are given. Author (TAB)

N67-16223# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
ABSOLUTE MEASUREMENT OF ACTIVITIES OF BETA SOURCES BY A 4π COUNTER [BEZWZGLEDNY POMIAR AKTYWNOSCI ZRODEL PROMIENIOWANIA β PRZY POMOCY LICZNIKA 4π]
M. Kaczmarek and S. Malewski *In its* Nukleonika, Vol. VIII 1966 p 28–39 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

A study was made of the use of 4π counters to make absolute measurements of β and β–γ activities. An accuracy of 2–3% was obtained for beta-sources with a maximum particle energy of more than 0.5 MeV. The conditions were determined for the probability of registration in the counter to be 1–0.0047 for various nuclides. The characteristics of counters for different discrimination and amplification voltages were plotted. Measurements were made of the absorption in aluminum foil which was put under the source. The pulse losses due to the finite resolving time were found as a function of the counting rate. Author

N67-16254# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
NOTE ON THE INTEGRATED INTENSITY IN THE TIME-OF-FLIGHT METHOD FOR CRYSTAL STRUCTURE INVESTIGATIONS
B. Buras *In its* Nukleonika, Vol. VIII 1966 p 236–237 ref (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

Described, checked experimentally, and discussed is the time-of-flight method for neutron diffraction structure investigations of powdered crystals. In this method neutrons of variable wavelength are scattered on a powdered crystal and the intensity of the scattered neutrons at a fixed angle 2θ is measured by means of a neutron counter connected to a multichannel time analyzer. As a result an intensity vs. wavelength curve showing distinct peaks is obtained. The peaks are indexed in the usual manner and in order to obtain the structure factors from the diffraction pattern it is necessary to measure the integrated intensities, adjust them for the neutron spectrum given by the chopper and take into account that the integrated intensities are proportional to λ^4. The aim of this note is to derive the full formula for the integrated intensity E to be used in this case. We shall use the kinematical theory of neutron diffraction, ignore the effect of thermal vibrations, absorption and extinction and assume that the structure factor is, if at all, a slowly wavelength dependent function. Author

N67-16262# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
PROBLEMS OF THE OPTICAL MODEL FOR DEUTERONS. I: PARAMETERS OF THE OPTICAL POTENTIAL [ZAGADNIENIA MODELU OPTYCZNEGO DLA DEUTERONOW. I: PARAMETRY POTENCJALU OPTYCZNEGO]
K. Grotowski *In its* Nukleonika, Vol. VIII 1966 p 266–277 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

Problems concerning the optical model are discussed. Some special properties of deuterons as projectiles may affect the optical model describing their interaction with nuclei. Author

N67-16263# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
PROBLEMS OF ELASTIC SCATTERING OF DEUTERONS ON ATOMIC NUCLEI. I: ANGULAR DISTRIBUTIONS FOR ELASTIC SCATTERING OF DEUTERONS [ZAGADNIENIA ELASTYCZNEGO ROZPROSZENIA DEUTERONOW NA JADRACH ATOMOWYCH. I: ROZKLADY KATOWE ELASTYCZNYM ROZPROSZENIU DEUTERONOW]
A. Strzalkowski *In its* Nukleonika, Vol. VIII 1966 p 278–289 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The relations between experiments on the elastic scattering of particles and the optical model of atomic nuclei are presented. There is a discussion of the results obtained from measurement of angular distributions in elastic scatterings of deuterons on atomic nuclei and particularly of the energy dependence of these angular distributions. Author

N67-16270# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
PROBLEMS OF THE OPTICAL MODEL FOR DEUTERONS. II: EXPERIMENTS TO DETERMINE THE PARAMETERS OF THE OPTICAL POTENTIAL FOR DEUTERONS [ZAGADNIENIA MODELU OPTYCZNEGO DLA DEUTERONOW. II: EKSPERYMENTY DLA WYZNACZENIA PARAMETROW POTENCJALU OPTYCZNEGO DLA DEUTERONOW]
K. Grotowski *In its* Nukleonika, Vol. VIII 1966 p 327–341 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

An experiment to determine the parameters of the optical potential for deuterons is presented. The total reaction cross sections for the interaction of deuterons with nuclei have been determined by evaluating the cross sections for the emission of charged particles and neutrons. The angular distribution for the elastic scattering of deuterons has also been measured. Author

N67-16271# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
PROBLEMS OF ELASTIC SCATTERING OF DEUTRONS ON ATOMIC NUCLEI. II: POLARIZATION IN ELASTIC SCATTERING OF DEUTRONS [ZAGADNIENIA ELASTYCZNEGO ROZPRASZANIA DEUTERONOW NA JADRACH ATOMOWYCH. II: POLARYZACJA W ELASTYCZNYM ROZPROSZENIU DEUTERONOW]
A. Strzalkowski *In its* Nukleonika, Vol. VIII 1966 p 342–358 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The formalism is given for the presentation of particles with spin 1. Also discussed are the results of measurements of polarization in elastic scattering of deuterons on atomic nuclei and experiments on nuclear reactions with polarized deuterons. Author

N67-16279# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
ABSOLUTE THERMAL NEUTRON DENSITY MEASUREMENTS BY THE ACTIVATION METHOD USING LIQUID SCINTILLATORS
E. T. Jozefowicz *In its* Nukleonika, Vol. VIII 1966 p 400–406 refs Presented at the 3d Intern. Conf. on Reactor Phys. and Eng., Prague, Apr. 1963 (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

Details of the method of absolute beta activity measurements by dissolving the active sample in liquid scintillator and extrapolation of the bias curves to zero point of discrimination are worked out. This method was used for the absolute thermal neutron density measurements by activation method using five nuclides: phosphorus, sodium, iodine, manganese and indium. For all these elements suitable chemical compounds soluble in the liquid scintillator were chosen and the whole chemical procedure was developed. In favorable conditions neutron densities in the range from 10^{-2} to 10^{3} n/ccm can be measured with the accuracy of 4%. Author

N67-16280# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

THERMAL NEUTRON ACTIVATION CROSS-SECTION OF SOME NUCLIDES USED IN ACTIVATION MEASUREMENTS

E. T. Jozefowicz *In its* Nukleonika, Vol. VIII 1966 p 407–411 refs Presented at the 3d Intern. Conf. on Reactor Phys. and Eng., Prague, Apr. 1963 (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The method of absolute beta activity measurements in liquid scintillators was used to measure the thermal neutron activation cross-sections of phosphorus, iodine, and indium in relation to sodium and manganese. The following results were obtained: $\sigma_{oP}=0.172\pm0.008$ b; $\sigma_{oI}=5.8\pm0.2$ b; $\sigma_{oIn}=154\pm6$ b and $\sigma_{oMn}/\sigma_{oNa}=25.0\pm0.2$. Author

N67-16284# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

SILICON DETECTORS OF THERMAL NEUTRONS [KREMNIEVYE DETEKTORY TEPLOVYKH NEITRONOV]

J. Chwaszczewska and A. Szechter *In its* Nukleonika, Vol. VIII 1966 p 454–458 refs Presented at the 3d Intern. Conf. on the Phys. and Technol. of Exptl. Reactors, Prague, Apr. 1963 (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

Surface-barrier detectors for charged heavy particles were covered with a layer of boron, lithium and uranium for use to detect thermal neutrons. The sensitive area of the detectors ranged from 10 to 500 mm^2. The silicon used for these detectors had a resistivity of 265 and 1000 ohm–cm. Their efficiency was measured and some of their characteristics determined. Author

N67-16285# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

4π-SCINTILLATION COUNTER FOR SMALL BETA ACTIVITY MEASUREMENTS [LICZNIK SCYNTYLACYJNY O GEOMETRII 4π DO POMIARU MALYCH AKTYWNOSCI BETA]

I. Natkaniec and T. Niewiadomski *In its* Nukleonika, Vol. VIII 1966 p 459–465 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

To determine the activities of weakly active beta-active samples, a 4π scintillation counter, incorporating characteristics of the largest detection area possible within a full solid angle, was designed and fabricated for more accurate measurements. Experimental results indicate that this counter permits the measuring time to be reduced several-fold, which is achieved through the improved efficiency of the scintillation counter and the possibility of measuring samples of bigger masses at the same source thickness. Measuring time for samples of correspondingly bigger masses can be shortened by the same ratio. It is considered that if the photomultipliers are connected into an anticoincidence circuit and if the thickness of the scintillators is reduced further, it will be possible to cut the background by at least half. The counter is used for activity measurements of samples of radioactive contaminations in the air and precipitation. After one year's use for an average of 6 hours daily, this counter proved to be a very stable instrument suitable for the purposes mentioned. R.Ll.

N67-16294# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

SLOW NEUTRON SCATTERING BY BENZENE MOLECULES

F. Maniawski and K. Parlinski *In its* Nukleonika, Vol. VIII 1966 p 543–546 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The total neutron scattering cross section per proton bound in the benzene molecule was measured. The results were compared with the previously published total neutron cross section calculations and theory in three variants. The angular distribution of scattered neutrons by benzene molecules was also measured. Author

N67-16309# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

APPLICATION OF BACKSCATTERING OF BETA PARTICLES FOR DETERMINING HEAVY ELEMENTS IN SAMPLES OF VARIABLE MATRIX [ZASTOSOWANIE WSTECZNEGO ROZPROSZENIA CZASTEK β DO OZNACZANIA CIEZKICH PIERWIASTKOW W PROBACH O ZMIENNYM SKLADZIE MATRYCY]

B. Dziunikowski and A. Lubecki *In its* Nukleonika, Vol. VIII 1966 p 636–642 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

Based on the backscattering of beta particles, a method is discussed for determining lead in zinc–lead ore concentrates regardless of the zinc and iron contents. In the experimental spectrum obtained for beta radiation backscattered on various materials, a relation is seen between the most probable energy of the backscattered beta particles and the atomic number of the scatterer. It is also shown that the toal intensity of the backscattered beta radiation depends very strongly on the atomic number of the scattering material. The principle of the method is explained by using an example of a medium consisting of a light matrix, such as dolomite, in which zinc occurs as a hindering element and lead occurs as the element to be determined. The procedure, backed by experimental results, is presented for eliminating the matrix effects. M.G.J.

N67-16316# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

RECENT RESULTS ON SILICON SEMICONDUCTOR NUCLEAR PARTICLE DETECTORS IN POLAND

J. Chwaszczewska, M. Dakowski, W. Przyborski, M. Sowinski, A. Szechter et al *In its* Nukleonika, Vol. VIII 1966 p 701–715 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The following classes of these detectors were studied: (1) Surface barrier detectors with barrier depth up to 500 μ, high resolution and wide variety of shape and area (3 mm^2 to 8 cm^2). (2) The n-p junction detectors prepared by thermal diffusion of phosphorus into p-type silicon. The depletion layer was up to 100 μ and the window thickness 0.2 μ. (3) Lithium drifted detectors with depletion depth up to 1 mm and window thickness of 50–100 μ. (4) Gallium diffused boron–silicon detectors for neutron detection. The miniature surface barrier probe has been constructed for thermal neutron flux measurements. A set of highly stabilised electronic devices was used with the semiconductor detectors. This set consisted of low noise charge sensitive preamplifier with 4.3 keV f.w.h.m. noise, nonblocking amplifier and biased amplifier making it possible to extend the range of 100-channel amplitude analyser by 10–15 times. Author

N67-16353# Stanford Research Inst., Menlo Park, Calif.

RESEARCH ON METASTABLE SPECIES IN ATOMIC AND MOLECULAR BEAMS PRODUCED BY CHARGE TRANSFER Semiannual Report

Donald C. Lorents and James R. Peterson 31 Oct. 1966 18 p refs

(Contract DA-31-124-ARO(D)-446; ARPA Order 553; Proj. Defender)

(AD-642525) CFSTI: HC $3.00/MF $0.65

Methods of performing laboratory studies of excited-state reactions important to ionization and optical effects in reentry physics are being studied. Near resonance charge exchange reactions are being used to convert beams of ions to beams of neutrals containing a large fraction of excited particles. The high cross sections of these charge exchange reactions allow efficient conversion of ions to neutrals. Present studies are devoted to identification and detection of excited states of the neutrals in the beam. First results of this work are reported. One of the significant results is the realization of a direct and practical method of measuring radiation lifetimes of diatomic molecules. Author (TAB)

N67-16364# Brandeis Univ., Waltham, Mass. Dept. of Physics.
HARMONIC OSCILLATOR PHASE OPERATIONS
Edward C. Lerner Aug. 1966 20 p refs
(Contract AF 19(628)-5833)
(AFCRL-66-624; SR-1; AD-639952) CFSTI: HC $3.00/MF $0.65

Recent work on the quantum mechanical definition of harmonic oscillator phase is reviewed briefly and then reconsidered from a somewhat more systematic and general viewpoint. Starting with the classical Poisson bracket relations between the oscillator Hamiltonian and the sine and cosine of the phase angle, the possibility of using other operators than those used heretofore is discussed. For a broad class of such operators the spectra are obtained without resort to non-normalizable eigenvectors. The so-called coherent states are minimum uncertainty product states for phase and number in all cases considered. Author (TAB)

N67-16382# Stanford Univ., Calif. Stanford Linear Accelerator Center.
NEUTRON-PROTON ELASTIC SCATTERING FROM 1 TO 6.3 GeV
M. N. Kreisler Jul. 1966 122 p refs
(Contract AT(04-3)-515)
(SLAC-66) CFSTI: HC $3.00/MF $0.65

Results are presented of an experiment to measure the differential cross section of the n-p system from 1.0 to 6.3 BeV using a technique involving a neutron beam containing a broad spectrum of neutron energies, a liquid hydrogen target, and spark chambers. Experimental results are discussed for energies less than 1 BeV. Some of the present theories and models of elastic scattering are also discussed. NSA

N67-16387# Argonne National Lab., Ill. High Energy Physics Div.
LECTURES ON REGGE POLES AND THEIR PHENOMENOLOGICAL APPLICATION IN HIGH-ENERGY PHYSICS
R. C. Arnold Feb. 1966 70 p refs
(Contract W-31-109-ENG-38)
(ANL-7173) CFSTI: HC $3.00/MF $0.65

These lectures were divided into two parts. In one part the bound states and scattering from a nonrelativistic, potential-theory viewpoint are discussed. Regge poles are introduced as generalizations of bound states and scattering resonances. Regge trajectories are discussed as aids in classifying spectra of complex two-body systems with many bound or resonance states. A classification of presently known, strongly interacting particles and resonances is exhibited to the extent that data on the spectrum are presently available. In the second part, crossing relations and the Sommerfeld-Watson transform are employed to discuss the influence of Regge poles on low-momentum transfer, high-energy reactions in crossed channels. Phenomenological analyses of data from selected two-body reactions are discussed, and successes and failures of simple Regge-pole models are explicated. Peripheral models for inelastic reactions are treated as special cases. Finally, a (presently) semiphenomenological optical-model framework, including as a special case the absorptive correction method, is briefly described as an example of a more general approach to high-energy reactions in which the Regge poles appear as an approximation valid in the empirically successful cases described above. Author (NSA)

N67-16391# California Univ., Livermore. Lawrence Radiation Lab.
INVESTIGATION OF THRESHOLD PHOTONEUTRON CROSS SECTIONS FOR IRON AND BISMUTH
C. D. Bowman, G. S. Sidhu, and B. L. Berman 30 Jun. 1966 14 p refs
(Contract W-7405-ENG-48)
(UCRL-14942) CFSTI: HC $3.00/MF $0.65

Photoneutron cross sections were measured for iron and bismuth for photon energies up to 15 Mev above threshold by the neutron time-of-flight technique. A number of nuclear levels were observed. Nuclear properties derived from the data include ground-state γ-ray transition widths, γ-rays strength functions, and average level spacings. Author (NSA)

N67-16392# California Univ., Berkeley. Lawrence Radiation Lab.
ONE-DIMENSIONAL CALCULATION OF THE TIME-DEPENDENT CONDUCTIVITY OF GASES WITH A STRONG VARIABLE SOURCE OF IONIZATION
W. S. Barnes 26 May 1966 49 p refs
(Contract W-7405-ENG-48)
(UCRL-14914) CFSTI: HC $3.00/MF $0.65

A one-dimensional diffusion-mobility theory calculation involving the transport of ions and electrons in gases is described. The method of calculations is designed for application to problems involving (1) a strong variable source of ionization which is independent of the densities of the several ion species and (2) electric fields which are not independent of space charge effects. These calculations were carried out by computer programs which use an explicit differencing scheme and allow the overall voltage across the system to be varied by the effect of current flow in an external circuit. Quantities calculated as functions of space and time are the electric field, conductivity of the gas, ion, current, and source densities for electrons and positive and negative molecular ions. The current in the external circuit is also calculated as a function of time for comparison with experimental values. Author (NSA)

N67-16395# Los Alamos Scientific Lab., N. Mex.
GRAPHS OF CALCULATIONS OF ENERGY DEPOSITION AND AIR FLUORESCENCE FROM RADIATION PRODUCED BY A NUCLEAR EXPLOSION IN SPACE
E. W. Bennett 22 Apr. 1966 53 p refs
(Contract W-7405-ENG-36; ARPA Order 631)
(LA-3439-MS) CFSTI: HC $3.00/MF $0.65

Results of calculations of energy deposition in the atmosphere and air fluorescence produced by X-rays from a hypothetical nuclear explosion at an altitude of 10^5 km are presented in graphical form. The calculations were done for many parameters with the intent that the results would be useful in the detection of nuclear explosions in space, for example in systems design and signal interpretation, and in the prediction of atmospheric effects brought about by a high-altitude nuclear explosion. The machine codes used in performing the calculations are described briefly. In all cases an X-ray yield of 1 kt was assumed. Deposition calculations were done for a variety of source temperatures and incident proton energies ranging from a low temperature of 0.1 keV to a high temperature of 10 keV and for photon energies of 100 keV and 1 MeV. Deposition per unit volume as a function of altitude directly above a ground-based observer is presented for two cases: (1) burst at zenith, and (2) burst on the horizon. In the zenith case, the peak deposition varies only slightly with source temperature or photon energy, ranging between 2×10^{-15} and 0.8×10^{-16} joules cm^{-3}. The altitude of peak deposition, however, changes from 108 km for the 0.1 keV source to 80 km for the 1-keV source and 24 km for the 1-MeV photon source. For burst on the horizon, the peak deposition is lower by about two orders of magnitude, varying slightly about a value of 10^{-17} joules cm^{-3}, while the altitude of peak changes from 145 to 100 to 80 km for the 0.1-keV 1-keV, and 1-MeV sources, respectively. Air fluorescence calculations were done for a variety of source temperatures, detector fields of view and burst directions as seen by

an observer on the ground. An X-ray energy deposition coversion to fluorescence radiation efficiency of 1.4% was used. Graphs of the incident flux density as a function of time from 10 μsec to 250 μsec are given for burst locations ranging from zenith to 80° from zenith for detectors with fields of view 90°, 120°, and 160° in diameter, for a source temperature of 1 keV. Depending on burst location and field of view, the peak varies from a high of $8\times^{-8}$ W cm^{-2} to a low of 2.5×10^{-9} W cm^{-2}. Space-resolved and time-resolved plots of the air fluorescence apparent surface brightness as seen from the ground are presented for several burst locations. Peak brightnesses vary from 1.5×10^{-6} W cm^{-2} ster^{-1} to 5×10^{-9} W cm^{-2} ster^{-1} with typical values lying between 5×10^{-7} and 5×10^{-8} W cm^{-2} ster^{-1}. Author (NSA)

N67-16396# Sandia Corp., Albuquerque, N. Mex.
TABULATION OF ATOMIC SCATTERING PARAMETERS CALCULATED CLASSICALLY FROM A SCREENED COULOMB POTENTIAL
Felton W. Bingham Aug. 1966 42 p refs
(Contract AT(29-1)-789)
(SCR-RR-66-506) CFSTI: HC $3.00/MF $0.65

A screened Coulomb potential was used to calculate three quantities of interest in atomic scattering studies: distance of closest approach of the colliding atoms, impact parameter, and differential cross section. The results are tabulated as functions of scattering angle and of a parameter which depends upon the particular atomic species and bombarding energies involved in a given collision. Auxiliary tables are given to facilitate calculation of this parameter. The tables are generally useful for collisions in the energy range from approximately 100 eV to hundreds of keV; restrictions upon their validity are discussed briefly. Author (NSA)

N67-16397# California Univ., Berkeley. Lawrence Radiation Lab.
FORTRAN PROGRAM KINE: CALCULATING KINEMATICAL AND DYNAMICAL QUANTITIES FOR PARTICLE INTERACTIONS AND DECAYS
W. Peter Trower 1 Sep. 1966 17 p refs
(Contract W-7405-ENG-48)
(UCRL-11650, Rev.) CFSTI: HC $3.00/MF $0.65

FORTRAN program KINE is a calling routine for a collection of seven subroutines. Each subroutine calculates interesting kinematical and dynamical quantities for the particle reaction 1+2→3+4 by applying special relativity to the process in the form of the Lorentz transformation. The reaction is completely specified if, in addition to the rest masses involved, two of the physical variables are specified. The subroutines perform calculations for the most useful combinations of these two variables. Author (NSA)

N67-16399# Los Alamos Scientific Lab., N. Mex.
CALCULATIONS OF NEUTRON CROSS SECTIONS USING A LOCAL OPTICAL POTENTIAL WITH AVERAGE PARAMETERS
Ferne P. Agee and Louis Rosen 6 Sep. 1966 357 p refs
(Contract W-7405-ENG-36)
(LA-3538-MS, Vol. I) CFSTI: HC $3.00/MF $0.65

Neutron differential elastic scattering cross sections and total cross sections were calculated for a large number of nuclides at selected energies between 0 and 16 Mev. Comparison is made with experimental data. The elements and energies were selected on the basis of the AEC's Nuclear Cross Sections Advisory Group request compilation. Results are presented for nuclides with $6\leq A\leq 27$. NSA

N67-16400# Los Alamos Scientific Lab., N. Mex.
CALCULATIONS OF NEUTRON CROSS SECTIONS USING A LOCAL OPTICAL POTENTIAL WITH AVERAGE PARAMETERS
Ferne P. Agee and Louis Rosen 6 Sep. 1966 351 p refs
(Contract W-7405-ENG-36)
(LA-3538-MS, Vol. II) CFSTI: HC $3.00/MF $0.65

Neutron differential elastic scattering cross sections and total cross sections were calculated for a large number of nuclides at selected energies between 0 and 16 MeV. Comparison is made with experimental data. The elements and energies were selected on the basis of the AEC's Nuclear Cross Sections Advisory Group request compilation. Results are presented for nuclides with $28\leq A\leq 240$. NSA

N67-16413# Michigan Univ., Ann Arbor. Dept. of Physics.
DEUTERON PRODUCTION IN PROTON–PROTON COLLISIONS FROM 1.5 TO 3 GeV
David E. Pellett (Ph.D. Thesis) Aug. 1966 169 p refs
(Contract Nonr-1224(23))
(Rept.-03106-26-T; TR-26; AD-642585) CFSTI: HC $3.00/MF $0.65

The differential cross section for deuteron production in proton-proton collisions was measured for incident proton kinetic energies of 1.55, 2.5, and 2.9 GeV. Measurements were made at laboratory angles of 5.9, 11.55, 15.72 degrees, and at the two higher energies, at 20 degrees relative to the beam direction for deuteron laboratory momenta in the range 1.0-2.4 GeV/c. The center of mass differential cross section distributions obtained at the three energies of this experiment showed a general similarity to one another. The total deuteron production cross section decreased monotonically with incident proton kinetic energy. The cross section for production of deuterons associated with two or more pions had a maximum near 2 GeV. A search for pion resonances of unit isotopic spin in the mass range 400-1000 MeV through reactions of the form p + p to d + positive-x yielded evidence for RHO meson production. The laboratory distributions in momentum and angle of deuterons produced in proton-proton collisions at 2.9 GeV were found to be much different from those arising from proton-beryllium and proton-platinum collisions at the same energy. TAB

N67-16429# Wisconsin Univ., Madison. Theoretical Chemistry Inst.
ON THE VALIDITY OF THE DENSITY EXPANSION SOLUTION OF THE BBGKY EQUATIONS
Frank C. Andrews 1 Apr. 1966 7 p refs
(Grant NSF G-20725)
(WIS-TCI-167; PB-169910) CFSTI: HC $3.00/MF $0.65

There are severe restrictions on the validity of the standard density expansion of the BBGKY hierarchy. The usual expression for F_2 is incorrect at all orders, resulting in the divergences suspected in higher order terms. Author (TAB)

N67-16494# Armed Forces Radiobiology Research Inst., Bethesda, Md.
GAMMA RAY SPECTRAL ANALYSIS A Selected Bibliography
G. F. Mason Sep. 1966 26 p refs
(AFRRI-SP66-10; AD-643127) CFSTI: HC $3.00/MF $0.65

This bibliography is a collection of references which deals with the analysis of gamma spectra by all methods. Entries are limited to those sources which deal with the actual analysis phase of gamma spectroscopy but some details are present concerning equipment and sample preparation because many groups have published systems in their entirety. In every case, however, there is a section on data analysis after acquisition. Some references contain theoretical material necessary for the development of an operating system, or the results of studies of theoretical methods. All of the references are from the period 1956 to 1966. An author index is included. Author (TAB)

N67-16501*# United Aircraft Corp., East Hartford, Conn.
THEORETICAL INVESTIGATION OF THE ABSORPTIVE PROPERTIES OF SMALL PARTICLES AND HEAVY-ATOM GASES
N. L. Krascella Jan. 1967 74 p refs
(Contract NASw-847)
(NASA-CR-693) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Studies are presented for determining the spectral and mean absorption characteristics of solid and gaseous elemental materials that might be utilized to control the transfer of radiant energy in the propellant region of a gaseous nuclear rocket engine. Spectral extinction, absorption, and scattering parameters are calculated for spherical molybdenum, niobium, tantalum, and cadmium particles. Similar calculations were made for spherical tungsten particles. In addition, spectral absorption parameters of such materials as bulk aluminum, cadmium, carbon, cobalt, and hafnium are presented. The bulk absorption parameters apply to seeds in the form of thin plates and are generally higher than those for seeds in the form of spherical particles. Average reflectivities for a normally incident radiation, determined by weighting the normal spectral reflectivities with respect to the black-body radiation function, were computed for aluminum, copper, gold, nickel, silver, and tungsten. S.P.

N67-16522# Oak Ridge National Lab., Tenn.
PREPARATION OF XENON-131m, XENON-129m, AND KRYPTON-79
E. H. Acree May 1966 15 p refs
(Contract W-7405-ENG-26)
(ORNL-3839) CFSTI: HC $3.00/MF $0.65

Xenon-131m and xenon-129m were prepared from iodine isotopes by secondary neutron capture, and krypton-79 was prepared by utilizing the (n,γ) reaction on krypton gas enriched to ≈7% in 78Kr. A three-month irradiation of a 20-mg target of ^{129}I at a flux of 2×10^{14} n/cm^2 · sec produced 9.8 mC of ^{131m}Xe. Irradiation of 20 mg of ^{127}I for one month yielded 0.14 mC of ^{129m}Xe. A 1 cc (STP) enriched krypton target provided ≈1.2 mC of ^{79}Kr product of >99% purity. Author (NSA)

N67-16530# California Univ., Berkeley. Lawrence Radiation Lab.
HIGH-ENERGY PARTICLES DATA. VOLUME IV: RANGE-MOMENTUM AND DP/DX PLOTS OF CHARGED PARTICLES IN MATTER
W. Peter Trower 1 Jul. 66 p refs
(Contract W-7405-ENG-48)
(UCRL-2426; Vol. IV) CFSTI: HC $3.00/MF $0.65

Range-momentum and dP/d_x plots are presented for electron, muon, pion, kaon, proton, hyperon, dueteron, and alpha particle reactions with matter, the matter being aluminum, argon, beryllium, carbon, copper, emulsion, helium, hydrogen, lead, lithium, nitrogen, oxygen, and silver. NSA

N67-16534# California Univ., Livermore. Lawrence Radiation Lab.
MEASUREMENTS OF THE PROFILE OF THE ELECTRON BEAM FROM THE ASTRON ACCELERATOR
William S. Barnes and James E. Swain 3 Mar. 1966 12 p refs
(Contract W-7405-ENG-48)
(UCRL-14697) CFSTI: HC $3.00/MF $0.65

An experiment was performed to investigate the electron density profile of a 4-Mev electron beam from the Astron accelerator in air at various distances from the beam port. The results of this experiment and a technique by which such measurements may be made are included. Some knowledge of this profile is required in order to more accurately assess the results of measurements of the conductivity of air and other gases under bombardment with the Astron beam. Author (NSA)

N67-16540*# Oak Ridge National Lab., Tenn.
BIBLIOGRAPHY OF THE COMPUTER CODES LITERATURE EXAMINED BY THE RADIATION SHIELDING INFORMATION CENTER
Betty F. Maskewitz, Betty L. McGill, and Jane Gurney Jul. 1966 64 p refs
(NASA Order R-104(10); Contract W-7405-ENG-26)
(NASA-CR-81301; ORNL-RSIC-15) CFSTI: HC $3.00/MF $0.65

Literature is covered which describes not only shielding computer codes, but nuclear codes in a fringe area of shielding, and some miscellaneous information which might be of general interest. The reports are grouped according to the originating installations, with the report number listed in alphabetical and/or numerical order. The computer for which a code was written and the programming language in which it was written are indicated. NSA

N67-16607*# Consultants and Designers, Inc., Arlington, Va.
EFFECT OF RADIATION ATTENUATION UPON THE MOTION OF A RELATIVISTIC PARTICLE IN A UNIFORM MAGNETIC FIELD [VLIYANIYE RADIATSIONNOGO TORMOZHENIYA NA DVIZHENIYE RELYATIVISTSKOY CHASTITSY V ODNORODNOM MAGNITNOM POLE]
G. E. Gernet 10 Jun. 1966 5 p ref Transl. into ENGLISH from Dokl. Akad. Nauk SSSR, Ser. Fiz. (Moscow), v. 168, no. 2, 1966 p 63–64
(Contract NAS5-9299)
(NASA-CR-81270; ST-PF-10498) CSCL 20H

The effect of radiation decrease during the motion of a relativistic particle in a uniform magnetic field is obtained by deriving the equations for the transverse components and finding an approximate value of the proper time. Author

N67-16612*# Maryland Univ., College Park.
EFFECTS OF THE CONTINUUM ON THE O^{16} J=1⁻, T=1 LEVELS
W. P. Beres and W. M. MacDonald [1966] 7 p refs Presented at the 5th Session on Nucl. Models at the Gatlinburg Conf., Tatlinburg, Tenn., Sep. 1966
(Grant NsG-642)
(NASA-CR-81347) CFSTI: HC $3.00 CSCL 20H

Particle decay widths and energy shifts due to virtual transitions to the continuum are calculated for the five J=1⁻, T=1 particle-hole states of O^{16}. Single particle $1d_{3/2}$ width contributions are found to be non-negligible for the 17.7 and 25.1 MeV levels. The energy shifts are significant and may be as large as −1.40 MeV. Author

N67-16629*# Maryland Univ., College Park. Dept. of Physics and Astronomy.
VIRTUAL TRANSITIONS TO THE CONTINUUM IN O^{16}
W. P. Beres Aug. 1966 15 p refs
(Grant NsG-642)
(NASA-CR-81338; TR-611) CFSTI: HC $3.00/MF $0.65 CSCL 20H

The effect of the high momentum conponents of the repulsive hard core are usually included in the energy independent two-body interaction. Seldom considered, however, are the virtual transitions to low lying continuum states. As a test case, the shifts of the negative parity levels of O^{16} due to these low momentum off the energy shell transitions of both neutrons and protons have been calculated. Their contributions are found to be significantly large. Author

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N67-15342# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HIGH TEMPERATURE STABILIZED ELECTRIC ARCS OF HIGH POWER (ELECTRIC ARC PLASMOTORNS)
V. B. Tikhonov and Ye. A. Yakovlev 12 Jul. 1966 40 p refs Transl. into ENGLISH from Rabochyye Protsessy v Teplovykh Dvigatel'nykh Ustanovkakh, Aviats. Inst. (Moscow), Issue No. 119, 1960 p 43–71
(FTD-TT-65-1405; TT-66-62499; AD-640728) CFSTI: HC $3.00/MF $0.65

In order to stabilize the arc channel in plasmotrons one may use either water or other liquids, or even various gases (hydrogen, nitrogen, argon, atmospheric air and the like). If electric-arc plasmotrons are used in practice, in technical or physical investigations, the problem of determining such plasma parameters as composition, temperature, velocity, etc., is of particularly great importance. The solution of such problems is linked with several serious difficulties of both methodical and technical nature. Author (TAB)

N67-15659# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
LIMITING CASES IN THE THEORY OF SPHERICAL PLASMA PROBES
Karl G. Guderley Jun. 1966 82 p ref
(ARL-66-0113; AD-639956) CFSTI: HC $3.00/MF $0.65

The field around the probe in a monoenergetic plasma depends upon the probe radius (made dimensionless with a Debye length), the probe potential and the ratio of the energies of the repelled and the attracted charge carriers. The present report investigates conditions where some of these parameters become either very large or very small. The investigations round out the results of a former report, where only finite values of these parameters were considered. To obtain the desired limiting behavior formal limiting processes are carried out in the differential equation that governs the field around the probe. This method is by no means new, but the variety of examples that occur in the present problem might be rather instructive. For some of the limiting processes numerical results have been included. Author (TAB)

N67-15663*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
THREE-DIMENSIONAL PLASMA ACCELERATION THROUGH AXISYMMETRIC DIVERGING MAGNETIC FIELDS BASED ON DIPOLE MOMENT APPROXIMATION
H. G. Kosmahl Washington, NASA, Jan. 1967 28 p refs
(NASA-TN-D-3782) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The acceleration of a tenuous plasma whose initial energy is stored in the magnetic dipole moments of the electrons immersed in a diverging magnetic field was investigated theoretically. Adiabatic conservation of the dipole moments and axisymmetric steady-state fields were assumed, and three-dimensional trajectories of the plasma and the induced space-charge fields were computed. The computations were carried out for atomic weights of 40 and 130. The particle trajectories cross the field lines, and the plasma emerges as a well-defined beam. From the amount of divergence in the beam, a propulsive efficiency is defined. This efficiency is primarily a function of the radius and the length of the solenoid and the position beyond the center of the magnetic field at which the plasma of a given radial extension is initially injected. Conditions for a favorable design of a propulsion device are shown, and the mechanism of the acceleration process is explained. Results agree well with experiments performed on a microwave-powered plasma accelerator working under conditions that approximate the theoretical assumptions. A significant conclusion of these studies is that trajectories are independent of the ionic mass and the magnitude of the dipole moment, that is, of the energy of the particles. Author

N67-15696*# National Aeronautics and Space Administration, Washington, D. C.
CURRENT DISTRIBUTION IN PERMEABLE ELECTRODES INFLUENCED BY THE HALL EFFECT IN THE FLOW OF AN ELECTRICALLY CONDUCTING MEDIUM [O RASPREDELENII TOKA NA PRONITSAYEMYKH ELEKTRODAKH PRI NALICHII EFFEKTA KHOLLA V POTOKE ELEKTROPROVODNOY SREDY]
Yu. P. Yemets Dec. 1966 13 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), no. 3, 1966 p 35–41
(NASA-TT-F-10496) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The author considers the two-dimensional problem of the current distribution on the surfaces of permeable electrodes adjacent to a flow of an incompressible medium in which the Hall effect is taking place. Through the electrodes pass puffs of an electrically conducting medium with the same physical properties as the basic flow. It is shown that these puffs may be used to regulate distribution of current on the electrodes and to help stabilize it. Author

N67-15841*# National Aeronautics and Space Administration, Washington, D. C.
CHEMICAL EQUILIBRIUM OF MULTITEMPERATURE SYSTEMS [KHIMICHESKOYE RAVNOVESIYE MNOGOTEMPERATURNYKH SISTEM]
A. V. Potapov Dec. 1966 7 p refs Transl. into ENGLISH from Teplofiz. Vysokikh Temperatur, Akad. Nauk SSSR (Moscow), v. 4, no. 1, 1966 p 55–58
(NASA-TT-F-10495) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The law of mass action for a multitemperature system is derived. A formula is also derived for calculating equilibrium ionization when the electron temperature differs from the heavy-particle temperature. Author

N67-15960*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
CALCULATION OF THE EFFECT OF VISCOUS DRAG ON THE PERFORMANCE OF A COAXIAL PLASMA GUN
Joseph Norwood, Jr. Washington, NASA, Jan. 1967 27 p refs
(NASA-TN-D-3796) CFSTI: HC $3.00/MF $0.65 CSCL 20I

It is shown that under the assumptions of ionic impact as the dominant emission process in coaxial pulsed plasma guns and the second Townsend ionization coefficient much smaller than unity, a viscous drag force results which imposes a velocity limitation on the accelerated plasma. Calculations are presented to show that for operating conditions which optimize efficiency, the effect can seriously degrade the gun performance, particularly for those cases where the stored energy is small and where the current is oscillatory during the acceleration. Author

N67-15973# Michigan Univ., Ann Arbor. Dept. of Nuclear Engineering.
COLLISIONS IN IONIZED GASES
Jordan D. Lewis (Ph.D. Thesis) Oct. 1966 180 p refs
(Contract DA-31-124-ARO(D)-403; ARPA Order 675; Proj. Defender)
(AROD-6092-6; Rept.-07599-8-T; AD-642161) CFSTI: HC $3.00/MF $0.65

A study was made of the description and effects of particle interactions in ionized gases. The principal results are: (i) an expansion theorem for the linearized Fokker-Planck collision operator for each component of a two-component fully ionized gas, and (ii) a description of photon scattering from a partially ionized gas. It is shown that the Fokker-Planck collision operator generates a complete, continuous set of velocity-space eigenfunctions, for which high-speed asymptotic forms are found. Since the set is continuous, the expansion formula has the form of a generalized Fourier integral. The effect of neutral atoms on the spectrum of photons scattered by electrons in a partially ionized gas is shown to be primarily a reduction in height and increase in width of the two electron-plasma wings. The scattered photon spectrum is described for several characteristic cases. Author (TAB)

N67-15974# Army Electronics Labs., Fort Monmouth, N. J.
REMOVAL OF HYDROGEN IMPURITIES IN CLOSED NOBLE GAS DISCHARGE SYSTEMS
Rudolf G. Buser and John J. Sullivan Aug. 1966 32 p refs
(ECOM-2764; AD-641360) CFSTI: HC $3.00/MF $0.65

The removal of hydrogen, considered as an impurity gas, from a closed noble gas (helium) discharge system is studied using the techniques of (1) hydrogen pumping through a heated palladium membrane and (2) hydrogen gettering by a titanium film deposited on a water-cooled stainless-steel surface. Mass spectrometric and optical measurements are presented which show the effect of helium background on hydrogen removal rate. Experimental results of hydrogen gettering on titanium agree with theoretical calculations based on kinetic theory, and not only support, but extend earlier work of other investigators. Removal of hydrogen by the palladium membrane is about equally effective for the geometry employed. In addition, laser transmission measurements of deposition of titanium films on a glass surface are studied. Dependence of deposition rate and film thickness on helium background pressure, and source temperature are shown. Author (TAB)

N67-16142# Air Force Cambridge Research Lab., Bedford, Mass.
ENERGY TRANSFER FROM A TEST ELECTRON TO A COLLISIONLESS PLASMA
Joseph G. Kelley and Morton A. Levine Sep. 1966 32 p refs *Its* Phys. Sci. Res. Papers no. 263
(AFCRL-66-630; AD-641639) CFSTI: HC $3.00/MF $0.65

The perturbation of a collisionless plasma by a nonrelativistic test electron is derived in closed form. The electron loses energy driving currents in the plasma. No energy is lost to electromagnetic or electro-acoustic waves. However, electro-acoustic waves do occur in the Mach cone behind the test electron and provide a mechanism to couple test electrons over large distances. Author (TAB)

N67-16179# Institute for Defense Analyses, Arlington, Va. Research and Engineering Support Div.
CONVERGENT TRANSPORT COEFFICIENTS OF PLASMA
Adolf R. Hochstim Jun. 1966 117 p refs
(Contract ARPA SD-50)
(P-264; IDA/HQ-66-4959; AD-641429) CFSTI: HC $3.00/MF $0.65

Applying a series expansion of Laguerre polynomials in the solution of the plasma kinetic equation, in which Coulomb collisons are described by Fokker-Planck collision term and electron-neutral collisions by the Boltzmann collision term, elements of a 20 x 20 determinant (compared to 3 x 3 obtained by Landhoff and 4 x4 by Shkarofsky) were obtained for equilibrium plasma for the electron-electron and electron-ion contributions. At present convergence studies on dc and ac electric conductivity indicate slow convergence with increasing size of the determinant and, as a surprising feature, an oscillating solution as a function of the size of the determinant. TAB

N67-16198# Sylvania Electric Products, Inc., Waltham, Mass. Applied Research Lab.
RADIATION CONDITION FOR A MAGNETOPLASMA MEDIUM—I
S. R. Seshadri and T. T. Wu Nov. 1966 51 p refs
(Contract Nonr-3185(00))
(RR-502; AD-641661) CFSTI: HC $3.00/MF $0.65

The paper is concerned with the radiation condition for an unbounded magnetoplasma which is both anisotropic and dispersive. The usual form of the celebrated Sommerfeld radiation condition pertains to an isotropic and nondispersive medium and is not applicable to a magnetoplasma. A technique based on the principle of causality for the resolution of the consequent ambiguity is discussed. The branch-points and the associated branch-cuts of the integrands in the Fourier integral representations of the two modes which compose the actual field component in a steady state problem are examined with particular emphasis on certain of the branch-points which have been overlooked in the existing literature. Author (TAB)

N67-16420# Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
KINETIC ENERGY DISTRIBUTION OF NEGATIVE IONS FORMED BY DISSOCIATIVE ATTACHMENT AND THE MEASUREMENT OF THE ELECTRON AFFINITY OF OXYGEN
P. J. Chantry and G. J. Schulz 3 Oct. 1966 43 p refs
(Contract Nonr-2584(00); ARPA Order 125-63; Proj. Defender)
(TR-34; AD-641848) CFSTI: HC $3.00/MF $0.65

The kinetic energy distribution of ions produced by a dissociative ionization process is derived, taking into account the effect of thermal motion of the target molecule. In the case of dissociative attachment of monoenergetic electrons to a diatomic molecule the width at half maximum of the negative ion energy distribution is given by sq.rt.(11(Beta)kTE) where Beta is the ratio of the mass of the ion to that of the parent molecule, T is the target gas temperature, and E is the most probable ion energy. Using a crossed field velocity filter O(-) ion energy distributions arising from the attachment of essentially monoenergetic electrons to O2 are studied as a function of electron energy at two gas temperatures. The measured widths of the distributions are consistent with the above relationship. Measurements of E as a function of the electron energy allow a determination of the electron affinity, A, of atomic oxygen. The result, A = 1.5 plus or minus 0.1 eV, is in excellent agreement with photodetachment threshold determinations. Author (TAB)

N67-16441# Minnesota Univ., Minneapolis. Dept. of Electrical Engineering.
STUDY OF BASIC PROCESSES IN GASEOUS DISCHARGE PLASMAS Final Report, 1 Jul. 1960–1 Jul. 1966
1 Jul. 1966 16 p refs
(Contract Nonr-710(37); Proj. Defender)
(AD-640582) CFSTI: HC $3.00/MF $0.65

The report gives a brief summary of the results obtained during the study of collision processes between particles present in a gaseous plasma. A list of publications, verbal presentations and technical reports during the contract period is added. Author (TAB)

N67-16458# Florida Univ., Gainesville. Dept. of Electrical Engineering.
ELECTRON BEAM-PLASMA INTERACTION. THE PLASMA MAGNETRON Final Report, 1 Jan. 1965–1 Mar. 1966
William E. Lear and Alan D. Sutherland 1 Aug. 1966 32 p refs
(Grant AF-AFOSR-839-65)
(AFOSR-66-1991; PM-1; AD-640418) CFSTI: HC $3.00/MF $0.65

A low-power plasma-loaded smooth-bore magnetron is investigated experimentally. Two experimental versions are described. The first, operating under a bell-jar with a 500 gauss permanent magnet, exhibited oscillations in the range 300-500 mHz and 2-3 gHz. The second, a demountable structure operating in a variable magnetic field, exhibited oscillations in the range 970-1000 mHz. A theoretical model is discussed which postulates the interaction of the negative space-charge wave of a rotating cloud of primary electrons with the azimuthally traveling waves associated with the quasi-static modes of the plasma. The plausibility of this model is discussed but an experimental verification of its applicability was not achieved. Author (TAB)

N67-16486# Lockheed Missiles and Space Co., Sunnyvale, Calif.
PRODUCTION AND STUDY OF A CESIUM PLASMA IN THERMODYNAMIC EQUILIBRIUM Final Report, 17 May 1963
16 May 1966 29 p refs
(Contract DA-31-124-ARO(D)-105)
(LMSC/2-78-66-1; AROD-4336-1; AD-641854) CFSTI: HC $3.00/MF $0.65

The document describes means for producing a plasma in thermodynamic equilibrium without externally applied potentials. A cesium plasma is produced in an almost completely closed container, the container being maintained at a high temperature. Due to the low ionization potential of cesium (3.87 ev), one can obtain plasmas of interesting densities and properties at temperatures from 1500 to 2500K. Such plasmas have properties dependent only on temperature, the energy levels of cesium (strictly speaking of both neutral and ionized states), the work function of the container, and on the total amount of cesium present. Author (TAB)

N67-16516*# Consultants and Designers, Inc., Arlington, Va.
PLASMA BREMSSTRAHLUNG [TORMOZNOYE IZLUCHENIYE IZ PLAZMY]
A. D. Pataraya and V. I. Svimonishvili 18 Sep. 1966 5 p refs Transl. into ENGLISH from Radiofizika (Gorkii), v. 8, no. 3, 1965 p 628–629
(Contract NAS5-3760)
(NASA-CR-81274; ST-PP-10386) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Plasma bremsstrahlung is considered, taking into account the thermal flow of electrons and ions and of electrons' directed motion. The coherency effect has not been taken into account in this work. The results are brought out in a system, when $h=c=1$, while the temperature is measured in units of energy. Author

N67-16520* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ANALYSIS AND APPLICATION OF THE DIELECTRIC CONSTANT OF A TWO-TEMPERATURE PLASMA
E. H. Klevens and J. R. Primack 1 Feb. 1967 46 p refs
(Contract NAS7-100)
(NASA-CR-81287; TR-32-888) CFSTI: HC $3.00/MF $0.65 CSCL 20I

A discussion is presented of three problems which arise in the study of fully ionized plasmas where the electron temperature exceeds the ion temperature. In the first problem, the dielectric constant of a two-temperature plasma is analyzed to determine the conditions under which ion waves will be found, accurate values for the phase velocity and damping rate of ion waves, the validity of approximate expressions for the ion wave phase velocity and damping, and the behavior of the dynamic shielding factor when ion waves are possible. The second problem concerns the numerical evaluation of the high-frequency conductivity of a two-temperature plasma. Approximations and their validity are discussed. Results are presented for the real part of the conductivity as a function of frequency with the electron-to-ion temperature ratio as a parameter. For the third problem, the electrostatic energy per degree of freedom is computed. A comparison is made of numerical results obtained from approximate analytic expressions with those obtained from numerical integration of the exact expression. Author

N67-16558*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TWO-DIMENSIONAL UNSTEADY FLOW IN A TRAVELING WAVE PLASMA ACCELERATOR
Roger Peyret 1 Feb. 1967 30 p refs
(Contract NAS7-100)
(NASA-CR-81298; JPL-TR-32-1018) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The unsteady flow is studied by means of the small-perturbation theory under the conditions of small magnetic Reynolds number and weak electro-magnetic interaction. The partial differential equation which determines the pressure is solved by using a Laplace transform. The other quantities are deduced from the pressure by integration of rather simple equations. Then, the analytical results are numerically computed in order to clarify the effect of different parameters. Author

N67-16581# Institute for Defense Analyses, Washington, D. C. Jason Div.
GENERAL THEORY OF RESISTIVE BEAM INSTABILITIES
Steven Weinberg May 1966 109 p refs
(Contract ARPA SD-50)
(IDA/HQ66-4868; AD-643355) CFSTI: HC $3.00/MF $0.65

A study was made of all resistive instabilities of a self-pinched cylindrically symmetric beam of charged particles in a finite or infinite ohmic plasma channel. The problem is reduced to an ordinary second-order linear differential equation for the longitudinal component of the perturbed electric field. The equation can be solved for a uniform beam shape, yielding an implicit transcendental equation whose roots define the various modes. It is found that for each azimuthal 'quantum number' m there are two infinite sequences of modes and two exceptional modes, except that some of these modes are missing for $m=0$, 1, and 2. In all modes stable oscillation is found at very low and very high frequencies, and instability at intermediate frequencies, the growth rates generally reaching maxima somewhat less than the betatron frequency. The largest maximum growth rate is in the 'hose' mode (the only exceptional mode for $m=1$) where it is approximately 0.29 betatron frequency. For a general smooth beam shape the catalog of modes is similar to that for a uniform beam, except that there also appears a continuous spectrum. Author (TAB)

N67-16618*# California Univ., Los Angeles.
INTERACTION BETWEEN ION BEAMS AND PLASMAS
A. W. Wong, D. Baker, and J. M. Sellen (TRW Systems) 1 Dec. 1966 14 p refs
(Grant NGR-05-007-66)
(NASA-CR-81340; N-2) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Preliminary results from studies of the interaction between a low energy cesium ion beam (1 to 30 eV) and a thermal cesium plasma (.25 eV) are reported. Investigations were made of the stability limits for low frequency oscillations in the ion beam-plasma system confined by a magnetic field. It was found that the density gradients supported by the magnetic field give rise to an aximuthal component to the unstable wave, thus changing the wave character from that in a homogeneous infinite plasma. Also investigated were the attenuation and the phase velocity of low frequency ion acoustic waves in a stable ion beam-plasma system. C.T.C.

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Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N67-15349# Microwave Electronics Corp., Palo Alto, Calif.
STUDY OF MICROWAVE GENERATION UTILIZING DOUBLE-STREAM INSTABILITIES IN ANISOTROPIC MEDIA Quarterly Progress Report, 1 Jan.–31 Mar. 1966
L. D. Buchmiller and S. Kakihana Ft. Monmouth, N. J., Army Electron. Command, Oct. 1966 41 p refs
(Contract DA-36-039-AMC-03424(E))
(Rept.-9; QPR-9; ECOM-03424-9; AD-640417) CFSTI: HC $3.00/MF $0.65

The computer results for the two-stream instability in pyrolytic graphite (PG) and bismuth (Bi) have been obtained. The instability frequency for the acoustical mode in the optimum crystalline direction (trigonal) is approximately 500 GHz wavelength = 0.6 mm) at the frequency of maximum growth rate. The current density required at the threshold of the instability is approximately 15 amp/sq mil. For PG, the corresponding frequency and current density requirement in the a-plane is 3 x 13 to the 13th power cps (wavelength = 10 microns) and 35 amp/sq mil. Experiments with PG samples of larger cross-sectional area have been unsuccessful even though the detection system sensitivity has been improved. Further experiments will be concentrated in Bi using an indium antimonide submillimeter detector operating at liquid helium temperature. Author (TAB)

N67-15356# Delaware Univ., Newark. Physics Dept.
TIME PERIODIC SOLUTIONS OF TRANSPORT- AND POISSON EQUATIONS FOR LAYERLIKE FIELD INHOMOGENEITIES
K. W. Boer Oct. 1966 46 p refs
(Contract DA-31-214-ARO(D)-173)
(TR-13; AD-640518) CFSTI: HC $3.00/MF $0.65

Time dependent solutions of the Poisson and transport equations containing drift and diffusion for the case of layerlike field inhomogeneities propagating underformed and with constant velocity through a crystal, are discussed in terms of an analysis of their projections in the n-E plane. Two principal models are discussed: one for a trap controlled crystal (CdS type), and the other for a trap-free crystal (GaAs type, Gunn effect) for field dependent recombination or field dependent mobility. It is found that, in addition to the triangular domains, periodic propagating solutions can exist. Conditions on the value of the layer velocity and the current are derived. Author (TAB)

N67-15408# Institute of Modern Languages, Inc., Washington, D. C.
DIFFUSED LAYERS OF SEMICONDUCTIVE COMPOUNDS OF GROUP III AND V [AUFDAMPFSCHICHTEN AUS HALBLEITENDEN III-V-VERBINDUNGEN]
K. Gunther Ft. Belvoir, Va., Army Engr. Res. and Devel. Labs., Oct. 1966 7 p refs Transl. into ENGLISH from Naturwissenschaften (Berlin), v. 45, 1958 p 415–416
(Contract DA-44-009-AMC-1563(T))
(FRDL-T-1877-66; TT-66-62543; AD-641277) CFSTI: HC $3.00/MF $0.65

With the semiconductive compounds of elements of group III and group V (indicate in ref. 1.) we have available substances characterized by a high Hall coefficient and high electron mobility and consequently particularly suitable for the production of efficient Hall elements, so-called Hall generators. Among these compounds, indium antimonide and arsenide are especially appropriate for this purpose. In order to increase sensitivity as well as for reasons of matching, it is desirable to produce compounds of this type in the form of thin films. If we utilize the method of vacuum diffusion, considerable difficulties result which are based, in the last analysis, on the different vapor pressures of the two individual components. As a consequence, the substances, under heating in vacuum, decompose, diffuse in fractions and give rise to the formation of inhomogeneous films which consist of superposed zones of the individual components. TAB

N67-15413# Illinois Univ., Urbana. Dept. of Metallurgy and Physics.
DISLOCATION MOTION VIEWED AS AN ELECTRON TUNNELING PROCESS
John J. Gilman Oct. 1966 25 p refs
(Contract Nonr-3985(06))
(AD-640664) CFSTI: HC $3.00/MF $0.65

The motion of a kink on a dislocation line is reduced to the dissociation of an electron from an adjacent atomic site and its transfer to the kink which thereupon moves. An explicit expression for the kink velocity is derived by means of tunneling. This relates it to the average energy gap, the atomic volume, and the applied stress in good accord with observations. Author (TAB)

N67-15668*# New York Univ., N. Y.
QUANTUM MECHANICAL STUDY OF MOLECULES: PREDICTION OF THE GROUND, IONIZED AND EXCITED STATES OF THE UNKNOWN NF MOLECULE
Roop C. Sanni Washington, NASA, Jan. 1967 23 p refs
(Grant NsG-76)
(NASA-CR-688) CFSTI: HC $3.00/MF $0.65 CSCL 20L

The ground, ionized, and exited states of the unknown NF molecule have been computed at a number of internuclear distances to determine their stability, equilibrium distances, ionization and excitation energies. In these calculations all the atomic and molecular integrals have been computed correctly to six decimal places. The configurations of the different states of NF have been derived from the configurations of the corresponding states of the isoelectronic O_2 molecule. The percentage accuracy of the computations of the states of NF has been estimated by carrying out similar types of calculations on the different states of the known N_2, CO, and O_2 molecules. Author

N67-15689*# National Aeronautics and Space Administration, Washington, D. C.
SUPERCONDUCTIVITY IN NBC–NBN SOLID SOLUTIONS [SVERKHPROVODIMOST V TVERDYKH RASTVORAKH NBC–NBN]
O. I. Shulishova Dec. 1966 8 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Neorganisheskiye Materialy (USSR), v. 2, no. 8, 1966 p 1434–1438
(NASA-TT-F-10446) CFSTI: HC $3.00/MF $0.65 CSCL 20L

A method was developed for obtaining niobium carbonitrides with a total content of metalloid atoms of ~50 at. percent. Investigated were also the dependence of the critical temperature on the degree of nitrogen deficiency in the region of the compound homogeneity; and the maximum critical temperature in solid solutions corresponding to the NbC–NbN section. K.W.

N67-15710*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RECENT PROGRESS IN CDS PHOTOCONDUCTORS
R. J. Stirn *In its* Space Programs Sum. No. 37-41, Vol. IV 31 Oct. 1966 p 41–46 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

The major properties of evaporated recrystallized layers of CdS are discussed and important applications of single evaporated crystalic CdS in photoconducting CdS cells are reported. It is established that parameters of recrystallized CdS layers can be

varied over a wide range depending on recrystallization procedures, e.g., O_2 or HCl partial pressure, treatment temperature, and environmental presence of N_2, O_2, HCl, Cu, at 630°C. The prevention of sulfur vacancies is crucial for obtaining high photoconductivity, since CdS ions act as recombination centers and reduce free electron lifetime. All CdS crystals show about the same electron lifetime of 10^{-3} to 10^{-4} sec once they were free of oxygen, regardless of any kind of impurity incorporation. High mobility CdS layers were grown without recrystallization by performing the evaporation in an ultra-high vacuum system of about 10^{-10} torr pressure on purified starting material. Protective multilayer coatings for CdS photodetectors stabilized their lifetime.
G.G.

N67-15785*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TITANIUM OXIDE THIN FILMS
J. Maserjian *In its* Space Programs Sum. No. 37-40, Vol. 4 31 Aug. 1966 p 20–21 ref (See N67-15781 06-34) CFSTI: HC $3.00/MF $0.65

Consideration is given to the possibility of developing a titanium oxide thin film thermal detector, which is tentatively designed as a thermactor. The thermactor is defined as essentially a thin film capacitor which exhibits a large temperature dependence; changes in capacitance caused by a temperature rise due to incident radiation enables this device to be used as a detector of infrared radiation. Equations are derived to show that radiative thermal impedance can be achieved for the thin film structure.
M.G.J.

N67-15845*# National Aeronautics and Space Administration, Washington, D. C.
THE DEPENDENCE OF CERTAIN ELECTROPHYSICAL AND THERMOPHYSICAL PROPERTIES OF ZIRCONIUM MONOCARBIDE ON CARBON CONTENT IN THE HOMOGENEITY REGION [ZAVISIMOST' NEKOTORYKH ELEKTRO- I TEPLOFIZICHESKIKH SVOYSTV MONOKARBIDA TSIRKONIYA OT SODERZHANIYA UGLERODA V OBLASTI GOMOGENNOSTI]
A. I. Avgustinik, O. A. Golikova, G. M. Klimashin, V. S. Neshpor, S. S. Ordan'yan et al Dec. 1966 6 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Neorganicheskiye Materialy (Moscow), v. 2, no. 8, 1966 p 1439–1444
(NASA-TT-F-10448) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Specific resistance, absolute thermoelectromotive force, and Hall's coefficient were studied in specimens of zirconium monocarbide synthesized from pure zirconium and carbon under vacuum and having a carbon content from 36 to 48 at. %. It is shown that the current carriers in zirconium monocarbide are free electrons. With a decrease in the content of the bound carbon there is a drop in electrical resistance, thermoelectromotive force, and Hall's coefficient, and a rise in thermal conductivity. This is caused by liberation of some of the valence electrons of zirconium from localized metal–carbon bonds. It was also found that as temperature rises, specific resistance and absolute thermoelectromotive force in the specimens rise linearly, while with reduction in carbon content the slope of the straight lines showing temperature dependence of electric resistance and thermoelectromotive force becomes smaller, which is probably due to the reduction of the effective mass of the conductivity electrons.
Author

N67-15962# General Dynamics Corp., San Diego, Calif. General Atomic Div.
OPTICAL STUDIES OF RADIATION DAMAGE PROCESSES Final Scientific Report, Mar. 25, 1963–Mar. 24, 1966
D. M. J. Compton 24 Apr. 1966 128 p refs
(Contract AF 19(628)-2926)
(GA-7140; AFCRL-66-427; AD-641725) CFSTI: HC $3.00/MF $0.65

The program used the high dose rate available from an electron linear accelerator to study radiation damage and excitation-de-excitation processes on a fast time scale. Fast optical techniques were used to study the processes occurring, and apparatus and methods were developed for measuring optical absorption and emission at nanosecond speeds. Progress was also made towards the application of high-speed electron spin resonance to these problems. These techniques were applied to a study of de-excitation, from the energy deposited by an electron pulse in ruby and in GaAs, and also to the kinetics of radiation damage in GaAs. In the alkali halides, absorption techniques were used to study the introduction and annealing of F centers; and the trapping of radiation produced electrons to form F centers. Fast optical techniques proved to give an important increase in the understanding of these processes, and are also useful in understanding radiation-induced conductivity in insulators. Optical absorption and photoconductivity measurements were made to study the kinetics of complex defect center formation in silicon: this work is still in a preliminary stage.
Author (TAB)

N67-15994# Martin Co., Orlando, Fla.
RESEARCH ON OPTICAL PROPERTIES OF SINGLE CRYSTALS OF BETA PHASE SILICON CARBIDE Summary Technical Report, 5 May 1965–5 Jun. 1966
P. B. Pickar, J. S. Ziomek and H. D. Tiller Oct. 1966 90 p refs
(Contract DA-28-017-AMC-2002(A))
(OR-8394; AD-641198) CFSTI: HC $3.00/MF $0.65

The report describes research work on beta silicon carbide. The work included: (1) the electroluminescent spectra of point contact and alloyed junction diodes under forward and reverse bias in the visible and near infrared region; (2) square and sine wave modulation of this electroluminescence; (3) photostimulated emission at liquid nitrogen temperature under ultraviolet pumping; (4) absorption spectra in the visible and near infrared region at several different temperatures; (5) reflection spectra at room temperature at two angles of incidence.
Author (TAB)

N67-15997# Brown Univ., Providence, R. I.
[PHYSICAL, CHEMICAL, AND ENGINEERING RESEARCH IN MATERIAL SCIENCES] Fifth Annual Technical Report, Jul. 1, 1965–Jun. 30, 1966
30 Jun. 1966 158 p refs
(Contract ARPA SD-86)
(AD-641405) CFSTI: HC $3.00/MF $0.65

This fifth annual technical report outlines research in the materials sciences at Brown University for the period 1 July 1965 to 30 June 1966. Work carried out in the divisions of engineering and applied mathematics and the departments of chemistry, physics and geological sciences is described.
Author (TAB)

N67-15998# Pennsylvania State Univ., University Park. Materials Research Lab.
THE ELASTIC CONSTANTS OF SOME ALKALI HALIDES AS A FUNCTION OF TEMPERATURE AND COMPOSITION
Otis D. Slagle (Ph.D. Thesis) 1 Oct. 1966 199 p refs
(Contract Nonr-656(27))
(TR-3; AD-641653) CFSTI: HC $3.00/MF $0.65

The temperature dependence of the elastic constants was measured with high precision for NaCl, KCl, KBr, CsCl, CsBr and CsI and for the solid solution series KCl–KBr in the temperature range 25C to 400C. In the solid solution series KCl–KBr the general trend of the elastic constants versus composition was in agreement with theory but indicated that the dependency on interionic distance is greater than theoretically predicted.
Author (TAB)

N67-16029# General Electric Co., Schenectady, N. Y. Research and Development Center.
NEW SOLID-STATE DEVICE CONCEPTS
M. Aven, W. Garwacki, R. B. Hall, R. N. Hall, J. R. Richardson et al Sep. 1966 54 p refs
(Contract AF 19(628)-4976)
(SR-6; AFCRL-66-657; AD-641456)

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N67-16030# General Electric Co., Schenectady, N. Y. Research and Development Center.
NEW SOLID-STATE DEVICE CONCEPTS: DIFFUSION OF Se IN CdSe
R. B. Hall *In its* New Solid-State Device Concepts Sep. 1966 p 1–7 refs (See N67-16029 06-26) CFSTI: HC $3.00/MF $0.65

Data are given for the diffusion of Se in CdSe at 800°C. In general, it has been found that the diffusivity, D, of Se in CdSe increases as the pressure of Se, P_{Se}, in agreement with the diffusion behavior of Se in CdS and ZnSe. The diffusion profiles are for the most part nonnormal, in that for many cases the profiles show two distinct regions; also several anomalous time dependent effects have been observed. Author

N67-16031# General Electric Co., Schenectady, N. Y. Research and Development Center.
DIFFUSION AND SOLUBILITY OF Na IN CdS
H. H. Woodbury *In its* New Solid-State Device Concepts Sep. 1966 p 9–14 refs (See N67-16029 06-26) CFSTI: HC $3.00/MF $0.65

A preliminary measurement of the diffusion coefficient of Na in CdS at 800°C under excess sulfur gave a value of approximately 3×10^{-7} cm^2 sec^{-1}. It is noted that this rate of diffusion is sufficiently rapid so that a several hour firing essentially establishes equilibrium in samples 1 to 2 mm in size. Details are also given on efforts to establish the equilibrium solubility and nature of any defect interactions which was deemed a necessary step before determining the time and temperature dependence of the diffusion profiles in detail. It was found that Na diffuses rapidly in CdS, indicating an interstitial diffusion mechanism. Enhanced Na solubility in donor-doped material indicates, in addition, a substitutional form. In Cl-doped CdS it forms a rather stable NaCl complex molecule. A method of measuring the diffusion profile of Cl using radioactive Na is indicated. M.G.J.

N67-16032# General Electric Co., Schenectady, N. Y. Research and Development Center.
PHOTOCONDUCTIVITY IN $ZnSe_xTe_{1-x}$ p–n JUNCTIONS
M. Aven *In its* New Solid-State Device Concepts Sep. 1966 p 15–27 refs (See N67-16029 06-26) CFSTI: HC $3.00/MF $0.65

The photoconductivity excitation and quenching characteristics of bulk p- and n-type $ZnSe_xTe_{1-x}$ crystals are analyzed. Measurements show considerable overlap between the photoconductivity excitation bands in both p- and n-type crystals and the electroluminescent emission band of the diodes, thus confirming an earlier theory on the turn-on mechanism. Quenching bands were also found in both types of material, the one in the n-type being responsible for the infrared quenching observed in these diodes. Reduction of the contact resistance to the p-type side of the $ZnSe_xTe_{1-x}$ diodes makes it possible to turn them on at 77° K without an external light pulse. Also discussed are the characteristics of the very slow decay of photoconductivity following excitation by near-band gap radiation. It is shown that the rate of decay does not fit either monomolecular or bimolecular kinetics, and is nearly independent of temperature. It is suggested that the observed decay may involve an interimpurity recombination mechanism. M.G.J.

N67-16033# General Electric Co., Schenectady, N. Y. Research and Development Center.
ELECTRODING TECHNIQUE FOR SELF-STARTING $ZnSe_xTe_{1-x}$ DIODES
M. Aven and W. Garwacki *In its* New Solid-State Device Concepts Sep. 1966 p 27–29 refs (See N67-16029 06-26) CFSTI: HC $3.00/MF $0.65

Studies with ZnTe crystals were conducted in an effort to prepare diodes in such a way as to minimize Au diffusion into the crystals. The crystals were etched with a 50% solution of NaOH and two small Au dots were plated on their surface. They were then fired in H_2 atmosphere, and the resistance between the Au dots was determined at 300° K. The electrodes were subsequently removed with KCN, the crystals re-etched and re-electroded, and the firing repeated at a different temperature. Results show that both the omission of the firing, as well as firing at temperatures in excess of about 150°C, increases the contact resistance. Tests to validate the data were also conducted. Based on these findings, the following electroding procedure was adopted for the $ZnSe_xTe_{1-x}$ diodes: The In–Hg contact that has to be fired in at 250° C was formed first; the crystal was then re-etched by a short immersion in warm 50% NaOH solution, the Au contact was plated on, and fired at 100° C for 30 seconds. M.G.J.

N67-16054*# General Precision, Inc., Little Falls, N. J. Aerospace Research Center.
BEAM ALIGNMENT TECHNIQUES BASED ON THE CURRENT MULTIPLICATION EFFECT IN PHOTOCONDUCTORS Summary Technical Progress Report
Raymond P. Borkowski, Robert Carvalho, Joseph C. Scanlon, Aryeh H. Samuel, and Daniel Grafstein Nov. 1966 82 p refs
(Contract NAS12-8)
(NASA-CR-80004; STPR-2) CFSTI: HC $3.00/MF $0.65 CSCL 20L

The photoconductive multiplication effect and the ratio of current increase were investigated for possible utilization in space communication, navigation, and information systems. A mathematical model of this effect was constructed, which in principle could describe the observed data on the basis of the geometry of charge carrier deposition, diffusion, recombination, and motion in the electric field. Several Fortran programs were written to obtain calculated values of the photoconductive multiplication factor, and an effort to match observed and calculated data was initiated. A breadboard model of a beam alignment device based on this effect was designed, constructed, and demonstrated. Measurements based on this model indicate the feasibility of using the photoconductive multiplication effect in space communications. R.L.I.

N67-16077# Library of Congress, Washington, D. C. Aerospace Technology Div.
NONSTOICHIOMETRIC GALLIUM AND INDIUM CHALCOGENIDES OF THE $A_2^{III}B_3^{VI}$ TYPE

John Kourilo *In its* Foreign Sci. Bull., vol. 2, no. 11 Nov. 1966 p 15–77 refs (See N67-16075 06-34)

Experiments dealing with nonstoichiometric $A_2^{III}B_3^{VI}$ semiconductors, where A refers to gallium or indium and B to selenium or tellurium, are reviewed. Indium telluride alloys with nonstoichiometric impurity atoms form a narrow region of solid solutions that exhibit an exclusively intrinsic conductivity; and a crystallochemical mechanism formation of the solid solutions was established to explain the absence of extrinsic conductivity, as well as strengthening of the crystal lattice by interstitial nonstoichiometric atoms. Regions of solid solubility were also established in gallium telluride and selenide alloys, with nonstoichiometric Te or Se atoms. In additon to confirmation of the solid solubility of In in In_2Te_3, the extent of the single phase region of the In–Te diagram was determined. This solid solution on the In_2Te_3 alloy, a phase of variable composition and asymmetric shape, was considered characteristic of the compounds studied. Both disordered (α) and ordered (β) forms were observed, with the transition point for $\beta \rightarrow \alpha$ varying between 605 and 630°C, depending on alloy composition. M.W.R.

N67-16143# Harvard Univ., Cambridge, Mass. Gordon McKay Lab.

SYNTHESIS AND OPTICAL PROPERTIES OF FORSTERITE

T. J. Shankland Jul. 1966 170 p refs

(Contract Nonr-1866(10))

(HP-16; AD-641363) CFSTI: HC $3.00/MF $0.65

The report describes the growth of what are believed to be the first synthetic single crystals of appreciable size of Forsterite, Mg2SiO4, and the measurement of optical absorption in these crystals. A limited number of measurements of electrical conductivity as a function of temperature were also made. It is shown that the pure magnesium orthosilicate is a very good insulator, and that the interesting optical properties observed in natural olivines are due to the presence of iron. Author (TAB)

N67-16159# Bausch and Lomb, Inc., Rochester, N. Y. Research and Development Div.

INFRARED COATING STUDIES Quarterly Report, 16 Jun.–15 Sep. 1966

R. L. Maier 15 Sep. 1966 6 p refs

(Contract DA-44-009-AMC-1707(E))

(QR-1; AD-641032) CFSTI: HC $3.00/MF $0.65

The report contains the results of investigations into new materials to be used as low index spacer layers in the fabrication of the A reststrahlen transmission filter. These include KRS-5, CsI, CsBr, SiO, and PbI2. In addition, an evaluation of Kapton polyimide film as a substrate material, is given for the 20 to 40 micron region. TAB

N67-16160# Aerospace Corp., El Segundo, Calif.

LOCALIZED COOLING IN FLUX CRYSTAL GROWTH, JULY 1965–MAY 1966

A. B. Chase and Judith A. Osmer Aug. 1966 20 p refs

(Contract AF 04(695)-1001)

(SSD-TR-66-174; TR-1001(9230-02)-1; AD-641305) CFSTI: HC $3.00/MF $0.65

Large crystals of a number of compounds have been grown from PbO-PbF2 flux systems utilizing a temperature gradient and localized cooling. The temperature gradient and localized cooling were induced by a jet of cold air directed on the crucible bottom. The temperature gradients of the crucible were measured and were found to be much less than the furnace temperature gradient. The technique is described, and a comparison is made of crystals grown with and without a temperature gradient. Author (TAB)

N67-16177# Naval Ordnance Lab., White Oak, Md.

MAGNETIC PROPERTIES OF THIN FILMS OF NICKEL–IRON–MOLYBDENUM

Guy H. Frindell 25 May 1966 58 p refs

(NOLTR-66-101; AD-641180) CFSTI: HC $3.00/MF $0.65

The properties of thin ferromagnetic films of nickel-iron-molybdenum are studied as a function of composition and method of manufacture. Experimental data are presented and discussed on magnetostriction, anisotropy, dispersion of anisotropy, coercive force, saturation induction, magnetoresistance, and resistance. Many of these results are in general agreement with data published by other authors; the principal exception is the dependence of the coercive force on substrate temperature. Author (TAB)

N67-16191# Brown Univ., Providence, R. I. Div. of Engineering.

OBSERVATIONS OF FERROMAGNETIC DOMAINS BY ANOMALOUS TRANSMISSION OF X-RAYS-1. THE EFFECTS OF VARIATION IN THE REFLECTING PLANE

Barton Roessler Aug. 1966 28 p refs Submitted for Publication

(Contracts AF 49(638)-1177; ARPA SD-86; Grant NSF GK-751)

(NSF-GK751/1; AD-642133)

The ferromagnetic domain patterns observed by anomalous transmission of x-rays in Fe-3pct Si crystals grown by secondary recrystallization are shown to depend on the choice of reflecting plane. The 110 reflection shows straight lines in the <100> directions which are sometimes resolved as zig-zag lines. The 200 reflections show surface closure domains which are the same as those seen in Bitter patterns; zig-zag boundaries and several other features are also seen. The importance of strain effects in determining the domain pattern is discussed. Author (TAB)

N67-16227# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

A TIME-OF-FLIGHT METHOD FOR NEUTRON DIFFRACTION CRYSTAL STRUCTURE INVESTIGATIONS

Br. Buras and J. Leciejewicz *In its* Nukleonika, Vol. VIII 1966 p 73–75 ref (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

As an experimental check on the feasibility of this method, some preliminary measurements were performed at the 2 MW reactor (average thermal neutron flux 10^{13} neutrons/sec cm^2). The intensity versus wave length curve obtained for an aluminum powder in a 40-hour run is depicted; a similar curve was obtained for lead powder. In both cases distinct peaks were observed very similar to those usually obtained for the conventional method. The peaks were indexed in the usual manner using the lattice constants, and good agreement between the calculated and measured positions was found. Observed and calculated intensities for aluminum powder are also compared. Results seem to indicate the feasibility of the method. However, possible drawbacks are cited as the wavelength dependent neutron cross sections, and the dependence of the neutron spectrum on the temperature of the reactor moderator. M.G.J.

N67-16272# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

X-RAY OBSERVATION OF Al-SINGLE CRYSTALS UNDER FAST NEUTRON BOMBARDMENT

Z. Szmid and S. Szarras *In its* Nukleonika, Vol. VIII 1966 p 357–362 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The mosaic structure of three samples of Al-single crystals was studied before and after fast neutron bombardment. A change in the mosaic structure dependent on the dose of the neutrons was ascertained. Some displacements of the individual mosaic blocks after fast neutron irradiation were observed. Author

N67-16301# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.
EFFECT OF THE GAMMA IRRADIATION ON THE ELECTRON WORK FUNCTION OF PLATINUM IN THE PRESENCE OF OXYGEN
J. Siejka *In its* Nukleonika, Vol. VIII 1966 p 590–592 *refs*
(See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

The influence of irradiation on the work function of platinum plate was investigated as a function of oxygen pressure. The influence of e.w.f. value of investigated samples before irradiation was examined on the effect observed after irradiation at the same oxygen pressure. It was found that irradiation caused changes of e.w.f. values but the magnitude of observed effects and/or their signs depend on the oxygen pressure and on the e.w.f. values of investigated samples before the irradiation. Author

N67-16325# Stanford Univ., Calif. Microwave Lab.
MICROWAVE RESEARCH Quarterly Status Report No. 30, 1 May–31 Jul. 1966
C. F. Quate et al Aug. 1966 16 p refs
(Contract Nonr-225(48))
(ML-1464; AD-640032) CFSTI: HC $3.00/MF $0.65

A report is given on the following projects: electroacoustic amplifiers, optical maser research, stimulated raman effect, geometrical optics of acoustic waves, oscillations in semiconductors, theory of nonuniform plasmas, bulk instabilities in ferromagnetic metals. TAB

N67-16339# Stanford Univ., Calif. Microwave Lab.
MICROWAVE RESEARCH Quarterly Status Report No. 29, 1 Feb.–30 Apr. 1966
R. W. H. Engelmann et al May 1966 23 p refs
(Contract Nonr-225(48))
(ML-1436; AD-640149) CFSTI: HC $3.00/MF $0.65

Topics included are: Acoustic wave amplification studies, optical maser research, tunable lasers, geometrical optics of acoustic waves, oscillations in semiconductors, theory of nonuniform plasmas, bulk instabilities in ferromagnetic metals. TAB

N67-16354# McGill Univ., Montreal (Quebec). Electronics Research Lab.
MAGNON SIDEBANDS IN $CsMnF_3$
Richard Stevenson Oct. 1966 5 p refs
(Contract Nonr-3013(00))
(TR-7; AD-641918) CFSTI: HC $3.00/MF $0.65

Magnon sidebands were observed in CsMnF3 in the 5420A region at 4.2K. The lines are similar in shape and intensity to those observed in the optical absorption spectra of MnF2. Author (TAB)

N67-16362# Westinghouse Electric Corp., Pittsburgh, Pa.
GROWTH AND CHARACTERIZATION OF SINGLE CRYSTALS OF RARE EARTH COMPOUNDS Final Report
R. R. Itsikes 31 Jul. 1966 6 p
(Contract AF 49(638)-1245)
(AD-640214) CFSTI: HC $3.00/MF $0.65

A summary is given of studies the results of which are of scientific interest, mainly in the theory of the interaction between a lattice defect and phonons, in showing how conduction electrons are scattered by magnetic impurities, and in methods of growth of single crystals of rare earth compounds. TAB

N67-16371# IIT Industrial Labs., Fort Wayne, Ind.
ULTRAVIOLET GENERATOR STUDY Final Report, 1 Jul. 1965–30 Jun. 1966
T. E. Sisneros and J. A. Davis Griffiss AFB, N. Y., RADC, Sep. 1966 71 p refs
(Contract AF 30(602)-3879)
(RADC-TR-66-497; ITTIL-66-1043; AD-641674) CFSTI: HC $3.00/MF $0.65

UV emitting cathodoluminescent phosphors were prepared and evaluated for emission wavelength, output power at high input power levels, aging characteristics, and decay time. Host materials studied were the zinc magnesium sulfide and several oxygen-dominated systems. A commercial P-16 phosphor was used as a standard against which the experimental samples were compated. Several lead-activated silicates were found to be superior to P-16 with respect to output power capability and aging characteristics. Ca3Si2O7:Pb with peak emission at 380 nm has output power at high input power equal to that of P-16 and equivalent or better aging characteristics. BaSi2O5:Pb with peak emission at 355 nm and BaZnSi4O10:Pb with peak emission at 305 nm have exhibited output power 25-50% higher than P-16 with superior aging characteristics. All of these materials have decay times (to the 1/e level) of 0.2-0.3 microsec which is about four times that of P-16. Author (TAB)

N67-16372# South Dakota School of Mines and Technology, Rapid City. Dept. of Physics.
THERMAL CONDUCTIVITY OF PURE AND IMPURE INDIUM ANTIMONIDE AT LOW TEMPERATURES
Emery J. Stephans (M.S. Thesis) 1 Oct. 1966 165 p refs
(Contract Nonr-2964(01))
(TR-19; AD-640993) CFSTI: HC $3.00/MF $0.65

The thermal conductivity of pure and impure InSb was measured in the temperature range 77-300K. The samples were placed between two Armco-iron standards. Copper-constanten thermocouples were attached to the standard-sample-standard combination to monitor temperatures at various points of the sandwich. To increase confidence in the data, the 77-300K range was covered twice for each sample. Computer-assisted data processing was used to reduce the possibility of human error. The thermal conductivity of both samples decreased with increasing temperatures. Values of 1480 mW/cm deg K AT °)K and 174 mW/cm deg K at 303K were determined for the thermal conductivity of the pure InSb sample. Values of 370 mW/cm deg K at 79K and 77 mW/cm deg K at 302K were determined for the thermal conductivity of the impure InSb sample. The thermal conductivity plot for the impure InSb sample was fitted with a theoretical curve calculated on the basis of Holland's modification of the Callaway analysis. The model included boundary scattering, impurity scattering, and phonon-phonon scattering. The magnitude of the electron-phonon scattering term was estimated. Impurity and possibly electron-phonon scattering can be held responsible for the lower thermal conductivity of the impure sample. Author (TAB)

N67-16378# Delaware Univ., Newark. Dept. of Physics.
INJECTION CAUSED p–n JUNCTION IN CdS
K. W. Boer and J. J. Ward [1966] 25 p refs
(Grant Nonr(G)-4336(00))
(TR-15; AD-641400) CFSTI: HC $3.00/MF $0.65

It is observed using the Franz-Keldysh effect that certain very pure CdS crystals show a high field layer close to, but well separated from, a hole injecting anode (Au). This layer is identified as a p-n junction caused by hole injection. Inversion of a IR quenching spectrum into a similar IR excitation spectrum is observed at an applied voltage where this high field layer becomes visible, and explained as caused by a current controlling p-type region in CdS. Author (TAB)

N67-16386# Argonne National Lab., Ill. Solid State Science Div.
VIBRATIONS OF DEFECTS IN LATTICES. FIVE LECTURES

R. J. Elliott and W. M. Hartmann Jul. 1966 42 p refs
(Contract W-31-109-ENG-38)
(ANL-7237) CFSTI: HC $3.00/MF $0.65

Notes from a series of five lectures on the vibrations of defects in crystals are presented. The lectures review many theoretical ideas current in research on vibrations in imperfect crystals. Principally, they relate the classical Green's-function techniques of Lifshitz and others to the more modern thermodynamic Green's-functions methods. The lectures cover perfect and imperfect crystals and Green's functions, solutions of the perturbed dynamical matrix (electron and magnon analogies), response of a system to a force and double-time Green's function, physical results from a double-time Green's-function treatment, and physically more realistic models. NSA

N67-16416# Naval Ordnance Test Station, China Lake, Calif.
VACUUM EVAPORATION STUDIES OF MERCURY TELLURIDE AND CADMIUM TELLURIDE
T. M. Donovan Oct. 1966 11 p refs
(NOTS-TP-4186; AD-641157) CFSTI: HC $3.00/MF $0.65

The conditions of evaporation and the resulting chemical composition have been studied for films of mercury telluride and cadmium telluride. Chemical analysis of the starting materials and the films revealed that the composition of the starting materials was not uniform and that there was little control over the composition of the resulting films. X-ray diffraction studies of evaporated alloy films deposited on glass substrates showed that these films were highly disordered. Author (TAB)

N67-16419# Carnegie Inst. of Tech., Pittsburgh, Pa.
KINETICS OF REACTIONS IN THE SOLID STATE Final Report, Mar. 1955–30 Sep. 1966
G. M. Pound 30 Sep. 1966 25 p refs
(Contract Nonr-760(08))
(AD-640424) CFSTI: HC $3.00/MF $0.65

Topics include: bulk thermodynamic properties, diffusion in metals and alloys, nucleation, growth in solids, evaporation, dislocations, and structure of polymers. TAB

N67-16433# Chicago Univ., Ill. Dept. of Physics.
FERMI SURFACE OF COPPER
E. I. Zornberg and F. M. Mueller [1966] 17 p refs
(Contract Nonr-2121(22))
(AD-642273) CFSTI: HC $3.00/MF $0.65

Accurate de Haas-van Alphen data for Cu of Joseph et al is analyzed using the expansion technique of Mueller. Cubic harmonic analysis is extended to treat multiply-connected geometries, thereby obtaining Fermi radii for Cu. These radii are then used in conjunction with Burdicks APW calculation and Muellers interpolation scheme to determine the Fermi energy EF and the position of the d-bands relative to the conduction bands (EF-L3). It is found that the value of EF-L3 so determined agrees with the optical data. The belly and neck cyclotron masses were calculated and compared with the experimentally obtained masses. The electron-phonon enhancement of the experimental masses (approx. 25%) was found to be almost independent of the location of the extremal orbit on the Fermi surface. Author (TAB)

N67-16510*# Stanford Research Inst., Menlo Park, Calif.
STUDY OF THIN DIELECTRIC FILMS FOR THERMO-DIELECTRIC ENERGY CONVERSION Quarterly Report, 1 Mar.–31 May 1966
C. Peltzer Jun. 1966 16 p refs
(Contract NAS2-3197)
(NASA-CR-81258; QR-3) CFSTI: HC $3.00/MF $0.65 CSCL 20L

The study of thin dielectric films for thermo-dielectric energy conversion is reported. The objective is to obtain a better understanding of the physical mechanisms underlying the response of certain thin film dielectrics during temperature cycling and under high electric field conditions. Temperature dependence of the dielectric constant of thin Mylar film has been investigated in vacuum as a function of frequency. Thermal cycling runs in vacuum between −50°C and 30°C gave values of β of the order of −0.0001; these values are in apparent contradiction to the positive value of the order of +0.001 to be expected from the capacitance bridge measurements. Author

N67-16568*# IIT Research Inst., Chicago, Ill.
CHARACTERIZATION OF CERAMIC MATERIALS FOR MICROELECTRONIC APPLICATIONS Summary Report No. 1, 23 Nov. 1965–23 Nov. 1966
A. J. Mountvala 23 Nov. 1966 113 p refs
(Contract NAS1-4870; IITRI Proj. G6006)
(NASA-CR-66253; IITRI-G6006-12) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Work was done to understand the intrarelationship between the dielectric behavior of the boundary phase of ceramics $BaTiO_3$ and the bulk phase as a function of microstructure. Both grain size and stoichiometry are significant parameters that effect the dielectric properties of polycrystalline $BaTiO_3$. However, the concentration and distribution of the various types of defects and secondary phases may vary differently in the bulk of the grain and along grain boundaries and, therefore, grain size and stoichiometry effects must be considered relative to each other. In addition, we have theoretically estimated the effect of a grain size dependent dielectric constant of the boundary phase on the effective dielectric constant of the ceramic. A model was proposed to support the experimental evidence for a high resistivity surface layer on $BaTiO_3$ grains. The change in the dielectric behavior of $BaTiO_3$ during the controlled conversion of compacted high-purity powders to increasingly densified and bonded ceramics was experimentally studied. The frequency dispersions of the dielectric constant, loss tangent, and conductivity were obtained and relaxation time constants evaluated. Author

N67-16585# Harry Diamond Labs., Wasington, D. C.
ENERGY LEVELS OF THE GROUND TERM OF TRIPLY IONIZED TERBIUM IN CALCIUM TUNGSTATE
Donald E. Wortman Dec. 1966 26 p refs
(HDL-TR-1337; AD-643142) CFSTI: HC $3.00/MF $0.65

An investigation of the absorption spectrum of Tb(+++) in CaWO4 over the infrared region was made to determine crystal field parameters. These parameters may aid in explaining the effect of crystalline fields upon the lasing properties of rare-earth ions when placed in host crystals of scheelite structure. Transitions were observed from our energy levels of the 7F6 ground state to energy levels of the 7F0, 7F1, 7F2, and 7F3 multiplets, where the crystal temperatures were between approx. 4.2 and approx. 77K. Effective crystal field parameters, B lm = A lm (rl), were determined by a least-squares-fit of calculated to measured energy levels. Russell-Saunders wave functions were used, and j-mixing was neglected in calculating the theoretical energy levels. The effective crystal field parameters were found to be: B20 = 386 plus or minus 64/cm, B40 = −534 plus or minus 55/cm, B60 = −183 plus or minus 86/cm, B44 = 302 plus or minus 217/cm, and B64 = 875 plus or minus 60/cm. Author (TAB)

N67-16642# Rensselaer Polytechnic Inst., Troy, N. Y.
INVESTIGATION OF TRANSIENT RADIATION DAMAGE IN SEMICONDUCTOR MATERIAL Quarterly Progress Report, 1 Apr.–30 Jun. 1966

John C. Corelli, A. Robb Frederickson, and James W. Westhead Sep. 1966 29 p refs
(Contract DA-28-043-AMC-01788(E))
(ECOM-01788-3; QPR-3; Rept.-3; AD-640804) CFSTI: HC $3.00/MF $0.65

The transient behavior of the resistivity and Hall effect voltage in 1 to 100 ohm-cm n-type silicon and in 100 ohm-cm p-type silicon has been studied following short bursts (< or = 4.5 microseconds) of 48 MeV electrons. The irradiations were performed with the sample temperatures in the 120-300 K range. The excess carrier lifetime is also determined by measuring the time decay of the resistivity voltage. The single dominant process which occurs is the production of excess carriers from ionization of atomic electrons, and their subsequent decay by recombination. The injection levels induced by the bombarding electrons are high (Delta n/n > 0.1) and in all cases the excess carrier lifetimes exhibit an increase with higher injection level. The number of excess carriers generated can be calculated within a factor of 2 from a knowledge of the ionization energy loss, the energy to form an ion pair, and the total integrated electron flux. The temperature dependence of induced conductivity as a function of injection is consistent with that predicted by theory. The transient Hall voltage response of 100 ohm-cm p-type silicon can be approximately reproduced by calculation assuming mixed hole-electron conduction and equal hole and electron decay times by a single time dependent exponential. A simple model to describe fast annealing in electron-irradiated silicon is given. Author (TAB)

N67-16892*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ULTRASONIC ATTENUATION IN SUPERCONDUCTING NIOBIUM
Joseph H. Simmons Washington, NASA, Jan. 1967 30 p refs
(NASA-TN-D-3817) CFSTI: HC $3.00/MF $0.65 CSCL 20L

The attenuation of ultrasonic waves with frequencies between 30 and 330 megahertz was investigated in niobium single crystals oriented in the (100) and (110) crystal directions. The dependence of the attenuation on temperature was observed with the samples in different background magnetic fields, and the temperature-dependence energy gap was calculated from the observed attenuation by using the Bardeen-Cooper-Schrieffer model. The experiment was performed on both annealed and unannealed niobium single crystals. Both longitudinal and shear waves were used. The study of longitudinal waves led to a determination of the anisotropy of the zero-temperature energy gap. Author

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N67-15455*# Union Carbide Corp., Tonawanda, N. Y. Linde Div.
SLUSH HYDROGEN PRODUCTION, STORAGE, AND DISTRIBUTION STUDY PROGRAM Final Report, 4 Nov. 1965–29 Apr. 1966
13 May 1966 97 p refs
(Contract SNPC-41)
(NASA-CR-81185) CFSTI: HC $3.00/MF $0.65 CSCL 21I

A study of the technological, economic, and logistic factors relating to the manufacture and distribution of slush hydrogen is presented in order to recommend a system of satisfying requirements. The system recommended is an 18 ton per day plant using the straight vacuum pumping process. Efforts focused on determining if slush production is limited to on-board tankage or if distribution of slush from a facility is feasible. Four processes for the production of slush hydrogen are considered: straight vacuum pumping, cascade vacuum pumping, external helium refrigeration, helium–hydrogen vapor recirculation and isentropic expansion of liquid hydrogen. Investigations were conducted to find the most attractive cycle and to define the size, location, and operating requirements of a plant. The conceptual design that is presented includes layouts, flowsheets, and estimated project schedules and costs. S.P.

N67-15780# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF THE ANTIWEAR PROPERTIES OF REACTIVE FUELS
A. P. Gryaznov and I. V. Rozhkov 12 Apr. 1966 11 p refs Transl. into ENGLISH from Khim. i Tekhnol. Topliv i Masel (Moscow), no. 4, 1964 p 57–60
(FTD-TT-65-1730; TT-66-62518; AD-641107) CFSTI: HC $3.00/MF $0.65

A procedure was developed which permits the evaluation of the properties of reactive fuels on a setup with fuel equipment used on a full-sized turbojet engine. In agreement with results obtained earlier, it was shown that of the standard reactive fuels, the highest antiwear qualities are had by the fuels T-5 and T-1, the lowest by the fuel T-2, the fuel TS-1 occupying a middle position. With the raising of the temperature of the fuel within the limits of from 60 to 150C, the wear of the frictional surfaces considerably increases. The addition to the fuel TS-1 of 0.01 - 0.02% of additives ionol (2,6-di-t-butyl-4-methylphenol) and V-15/2A (an organosulfur compound), which possess surface-active properties, makes it possible to improve the antiwear properties of the fuels. With the test of the fuel TS-1 with the additive ionol at temperatures higher than 100C there was noted the formation of deposits on the fuel equipment. Author (TAB)

N67-15898*# Stanford Univ., Calif. Dept. of Mechanical Engineering.
LIQUID PROPELLANT BEHAVIOR AT LOW AND ZERO g
William C. Reynolds and Hugh M. Satterlee (Lockheed Missiles and Space Co.) *in* Southwest Res. Inst. Dyn. Behavior of Liquids in Moving Containers 1966 p 387–439 refs Prepared in Cooperation with Lockheed Missiles and Space Co. (See N67-15884 06-12) GPO: HC $2.75; CFSTI: MF $0.65

The complex hydrostatic and hydrodynamic behavior of liquids under conditions of low and zero gravity are discussed in detail. Means of simulating this behavior in laboratory experiments are treated along with the various techniques for controlling the location and orientation of liquids within tanks subject to the weightless condition of the space environment. Author

N67-15959*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
OUTGASSING RATES OF TWO SOLID ROCKET FUELS IN VACUUM
Lawrence R. Greenwood Washington, NASA, Jan. 1967 35 p refs
(NASA-TN-D-3790) CFSTI: HC $3.00/MF $0.65 CSCL 21I

To determine the effects of vacuum exposure on solid rocket fuels, the outgassing rates of two solid rocket fuels were measured in vacuum at ambient temperature by the rate of rise method. The two fuels investigated were composites having polybutadiene acrylic acid (PBAA) and polyurethane as their binders. The outgassing rates were measured as a function of storage time in vacuum. The outgassing rate for the polybutadiene acrylic acid

fuel varied from 1.15×10^{-6} torr-liters/sec cm^2 after 1 hour of vacuum exposure to 8.32×10^{-9} torr-liters/sec cm^2 after 502 hours. The outgassing rate for the polyurethane fuel varied from 3.02×10^{-7} torr-liters/sec cm^2 after 17 hours of vacuum exposure to 3.17×10^{-7} torr-liters/sec cm^2 after 452 hours. The outgassing rates of both fuels decreased rapidly during the first 100 hours and then decreased more slowly with time. After about 500 hours in vacuum, the outgassing rate of both fuels was continuing to decrease. Author

N67-15984*# TRW Systems, Cocoa Beach, Fla.
EXPLOSIVES AND PROPELLANTS IN ACTION, PART I
J. Larks *In its* Explosive Safety Executive Lecture Ser. Jun. 1965 9 p (See N67-15981 06-34) CFSTI: HC $3.00/MF $0.65

The terms explosion, deflagration, and detonation are defined, and the differences between them are pointed out. Examples of explosions are given, and it is pointed out that an explosion is a result, not a cause or a chemical reaction in itself. The process of deflagration is described, and explosives are divided into two classes in relation to deflagration. Detonation was differentiated from deflagration by the manner in which the products flow and the speed of the reaction. Equations of motion for a one dimensional case (i.e., mass, energy, and momentum), values to derive an equation of state, and a fifth equation are given in order to calculate the characteristics of a given explosion. Finally, the creation and propagation of shock waves are considered. L.E.W.

N67-15985*# TRW Systems, Cocoa Beach, Fla.
EXPLOSIVES AND PROPELLANTS IN ACTION, PART II
G. J. Bryan *In its* Explosive Safety Executive Lecture Ser. Jun. 1965 11 p (See N67-15981 06-34) CFSTI: HC $3.00/MF $0.65

The behavior of propellants and explosives are considered in relation to safety planning. Exothermic reactions: burning, combustion, and deflagration; explosions; detonations; fuels and oxidizers; and specific impulse with exhaust velocity are defined and discussed. Damage assessment is covered, and details are given on its relation to total mass; mass consumption rate, confinement, and impact; and blast effects. Characteristics, sensitivity, types, and possible safety hazards are outlined for liquid propellants (monopropellants and bi-propellants), solid propellants (double-base and composite propellants, pyrotechnics, and combustion products), liquid explosives, and solid explosives (initiating and priming explosives, boosting explosives, and bursting or working charge). It is emphasized that facilities, equipment, and operations must be designed to prevent accidental ignition and minimize injury and destruction in case of accidents. L.E.W.

N67-15987*# TRW Systems, Cocoa Beach, Fla.
SENSITIVITY OF EXPLOSIVES AND PROPELLANTS TO IMPACT AND FRICTION
Frank Fedowitz, Jr. *In its* Explosive Safety Executive Lecture Ser. Jun. 1965 21 p (See N67-15981 06-34) CFSTI: HC $3.00/MF $0.65

The process from the point of initiation of explosives and propellants to either deflagration or detonation is summarized, and initiation by impact energy, friction energy, heating, and miscellaneous causes are reviewed. The effects on sensitivity by mechanical, chemical, and physical sensitizers are outlined. Various factors involved in measuring the sensitivity of propellants and explosives are discussed, and the sensitivity–brisance relations for some military explosives are presented. Different methods for measuring sensitivity are listed, and details are given on the following tests: impact, friction bullet impact, heat sensitivity, spark sensitivity, card gap, and grain defect tests. Crossover problems and scale-up problems are also considered. General rules for handling propellants and/or explosives are listed and explained. L.E.W.

N67-15988*# TRW Systems, Cocoa Beach, Fla.
SPECIAL PROBLEMS OF LIQUID PROPELLANTS PART I
L. T. Dombras *In its* Explosive Safety Executive Lecture Ser. Jun. 1965 11 p (See N67-15981 06-34) CFSTI: HC $3.00/MF $0.65

Since personnel create the most serious safety hazards in connection with the handling of liquid propellants, both initial and follow-up training programs are recommended to increase knowledge on safety procedures and to prevent accidents. Principles of liquid propellant motors are discussed, along with general propellant requirements. The latter treats economic factors affecting selection, physical and chemical properties desired, and operational requirements of liquid propellants. Liquid propellant systems discussed include monopropellants, bipropellants, hybrid propellant combinations, and thixotropic propellants. Pyrotechnic devices are mentioned, along with hypergolic and electrical energy ignition. Cryogenic, contamination, static electricity, spill, and adiabatic compression and ignition hazards are reviewed. M.W.R.

N67-15989*# TRW Systems, Cocoa Beach, Fla.
SPECIAL PROBLEMS OF LIQUID PROPELLANTS, PART II
G. N. Woodruff *In its* Explosive Safety Executive Lecture Ser. Jun. 1965 5 p (See N67-15981 06-34) CFSTI: HC $3.00/MF $0.65

Toxic hazard limits are defined, the maximum allowable concentration (MAC) that presents no danger to humans is discussed, and emergency tolerance limits (ETL) are included for typical liquid propellants. Presented as time-weighted numbers that establish exposure limits for varying concentrations of vapor based on exposure times, the ETL's are given for nitrogen dioxide, unsymmetrical dimethylhydrazine, and monomethylhydrazine. The MAC figures include additional liquid propellants; and both sets of limits are those which the body can withstand without either temporary or permanent injury. Hazard sources are considered, along with the minimization and control of toxic hazards. Suppression and neutralization methods of controlling hazards are mentioned. The only neutralization method is a chemical reaction, and this differs for each propellant. Vaporization rates from toxic propellant spills can be suppressed by fine water spray, freezing, or application of foam. M.W.R.

N67-16435# Atlantic Research Corp., Alexandria, Va. Kinetics and Combustion Group.
RESEARCH ON THE DEFLAGRATION OF HIGH-ENERGY SOLID OXIDIZERS Quarterly Technical Summary Report, 1 Jun.–31 Aug. 1966
G. von Elbe, J. B. Levy, R. Friedman, and E. T. McHale 30 Sep. 1966 27 p refs
(Contract AF 49(638)-1645)
(Rept.-3; AFOSR-66-2649; AD-642420) CFSTI: HC $3.00/MF $0.65

The chemistry and kinetics of reactions involving various oxides of chlorine were studied using the data obtained in the present investigation in conjunction with data reported in the literature. Additional experiments on the interaction of Cl_2O_3 with ClO_2 were performed in order to obtain more complete information on the effect of kinetic variables. The decomposition of ClO_2 is represented by the following reaction mechanism: $2ClO_2$ (on wall) to $ClO + ClO_3$; $ClO_2 + Clo$ to Cl_2O_3; $Cl_2O_3 + ClO$ to $ClO_2 + 2Cl + O_2$; $Cl + ClO_2$ to $2ClO$; $Cl + ClO_2$ to $Cl_2 + O_2$; Cl (on wall) to 1/2 Cl_2. It is shown that the observed characteristics of the explosive decomposition of ClO_2 are fully consistent with the reaction-kinetic equations developed on the basis of this scheme. Author (TAB)

N67-16559*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
STORAGE TESTS OF NITROGEN TETROXIDE AND HYDRAZINE IN ALUMINUM CONTAINERS
L. P. Hollywood, T. R. Metz, and R. N. Porter 15 Jan. 1967 27 p refs
(Contract NAS7-100)
(NASA-CR-81294; JPL-TR-32-1039) CFSTI: HC $3.00/MF $0.65 CSCL 21I

Small canisters of Types 2014 and 6061 aluminum alloy were subjected to short-term compatibility tests with nitrogen tetroxide and hydrazine to determine the effect of different cleaning procedures. Only minor differences were noted. A flight-weight propellant tank of Type 2014 aluminum alloy was used to store hydrazine for 46 months. At the end of that test, the tank was found to be only slightly corroded. Firing tests showed the stored fuel delivered slightly less performance; but it ignited and burned as smoothly with nitrogen tetroxide as stock hydrazine burned with nitrogen tetroxide. Author

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magneto-hydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N67-15666*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRELIMINARY ANALYSIS OF THE EFFECTIVENESS OF VARIABLE-GEOMETRY GUIDE VANES TO CONTROL ROTOR-INLET FLOW CONDITIONS
Ronald J. Steinke and James E. Crouse Washington, NASA, Jan. 1967 19 p refs
(NASA-TN-D-3803) CFSTI: HC $3.00/MF $0.65 CSCL 21A

A preliminary analysis of the effectiveness of variable-chamber inlet guide vanes in controlling rotor inlet flow parameters with flow change was made. Under study were four basic types of radial distributions of inlet tangential velocity as guide-vane-tip turning was increased to 45°. These distributions were the following functions of radius: inverse (free vortex), constant, linear (wheel-type), and quadratic. The computations were simplified by the assumptions of negligible streamline curvature, no radial-loss gradient terms, and no radial total-temperature gradients in the radial equilibrium calculation. Results show that mass flow can be reduced to 86% of the reference value of mass flow without changing the rotor-tip incidence angle. For all types of guide-vane turning. The maximum flow reductions are attained with the constant, linear, and quadratic tangential velocity distributions with respect to radius at guide-vane-tip turning angles ranging from 20° to 40°. For flow rates below 86% of reference mass flow, the rotor-tip incidence must be increased. The results of a study at a highly reduced mass flow show that either axial velocity redistributions or allowable incidence changes greatly restrict the degree to which rotor-tip incidence can be controlled at these reduced flows. Author

N67-15677*# Avco Corp., Wilmington, Mass. Space and Electronics Group.
DESIGN, DEVELOPMENT, FABRICATION, TEST AND DELIVERY OF ELECTROTHERMAL ENGINE SYSTEMS
Semiannual Report, Dec. 1965–Jun. 1966
Richard R. John Aug. 1966 110 p refs
(Contract NAS3-7934)
(NASA-CR-72104; AVSSD-0362-66-CR) CFSTI: HC $3.00/MF $0.65 CSCL 21H

A program for the design, development, fabrication, test, and delivery of an electrothermal three-axis attitude control and four-directional station-keeping system is reported. The basic electrothermal propulsion element is a fast heat-up ammonia-fueled resistojet which operates at a thrust level of 400 micropounds, specific impulse of 150 seconds, and a power level of less than 10 watts. The three-axis control system includes contract logic, power- and signal-conditioning packages, and an ammonia propellant fuel and storage system. The deliverable hardware, which is to be flight-quality welded-cordwood construction has been designed and prototype units are in the final stages of fabrication. Author

N67-15678*# Avco Corp., Wilmington, Mass. Space and Electronics Group.
RESISTOJET RESEARCH AND DEVELOPMENT, PHASE II. SUPPLEMENT NO. I: DESIGN, DEVELOPMENT AND FABRICATION OF AN AMMONIA-FUELED RESISTOJET THRUSTOR SYSTEM
Richard R. John Dec. 1966 27 p refs
(Contract NAS3-5908)
(NASA-CR-72123; AVSSD-0356-66-CR, Suppl. 1) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Two complete ammonia-fueled resistojet thrustor systems were delivered. The individual resistojet engines operate at thrust levels of 0.54 millipound and at specific impulse levels in excess of 120 seconds. The total system input power is less than 8.5 watts; the total propulsion system weight (filled) is 6.1 pounds, which included 0.9 pound of propellant. The resistojet thrustor system is compatible with 24-vdc input power. The signal-conditioning equipment includes provision for recording the clockwise and counterclockwise valve-on signals, the clockwise and counterclockwise heater-on signals, and the plenum pressure. The basic input signals are clockwise-thrustor-on and counterclockwise thrustor-on. The required operational system life of greater than 50 hours has been demonstrated in the laboratory. Author

N67-15719*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
APPLICATIONS TECHNOLOGY SATELLITE MOTOR DEVELOPMENT
D. R. Frank and R. G. Anderson *In its* Space Programs Sum. No. 37–41, Vol. IV 31 Oct. 1966 p 91–96 refs (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

Qualification tests were conducted on eight ATS apogee motors to establish a performance–temperature history for flight input information, and to demonstrate the acceptability of the motor hardware for flight use. During each test the motor was spun at 100 rpm. The first four motors were fired following a complete motor temperature conditioning at 100°F; the remaining four were temperature conditioned at 40°F before ignition. All motor component S/Ns used in the program are listed. Such important performance parameters as test conditions, and weight, time, pressure, and thrust data are tabulated. M.G.J.

N67-15731*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
STERILIZABLE LIQUID PROPULSION SYSTEM DEVELOPMENT
T. A. Groudle *In its* Space Programs Sum. No. 37–41, Vol. IV 31 Oct. 1966 p 151–156 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

To evaluate the heat sterilizability of monopropellant hydrazine for spacecraft application, a propulsion was constructed which included the following components: a heavy spherical stainless steel propellant tank, a squib-actuated, aluminum propellant valve, and a 50-lb_f monopropellant rocket engine with a spontaneous catalyst in the chamber. Heat sterilization cycles and instrumentation parameters monitored on the system are listed. The ability of a

monopropellant-hydrazine system to undergo heat cycling was demonstrated, and the thrust chamber assembly was found to perform satisfactorily. R.LI.

N67-15732*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
INJECTOR DEVELOPMENT: INVESTIGATION OF PROPELLANT SHEETS
R. W. Riebling *In its* Space Programs Sum. No. 37-41, Vol. IV 31 Oct. 1966 p 156-166 refs (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

To evaluate the design of injector elements based on the thin-sheet concept, an applied research program was conducted to determine the manner in which the dimensions and spatial orientation of such liquid sheets, as well as the velocity and mass distribution within them, vary with deflector geometry, injection velocity, and propellant physical properties. The results of the sheet formation studies are summarized. R.LI.

N67-15798*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ADVANCED LIQUID PROPULSION SYSTEMS
L. R. Toth, H. B. Stanford, and W. F. MacGlashan *In its* Space Programs Sum. No. 37-40, Vol. 4 31 Aug. 1966 p 47-49 (See N67-15712 06-34) CFSTI: HC $3.00/MF $0.65

Problems involved in overcoming the permeability of Teflon bladder film materials to the oxidizer nitrogen tetroxide (N_2O_4) are reviewed, along with the problem of propellant saturation by pressurant gases such as helium and nitrogen permeating through Teflon bladders. A method of laminating aluminum foil to Teflon film for composite bladder construction is outlined, and the steps for treating the aluminum foil surfaces are listed. A 90-day test of laminate samples placed with N_2O_4 in sealed glass containers showed no indication of delamination. It is also reported that a series of laser beam holes were pieced through foil in an attempt to produce a controlled hole size in the range of 0.0001 to 0.005-in. diameter in the foil for gas migration. M.G.J.

N67-15799*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
APPLICATIONS TECHNOLOGY SATELLITE (ATS) MOTOR DEVELOPMENT
R. G. Anderson and R. A. Grippi *In its* Space Programs Sum. No. 37-40, Vol. 4 31 Aug. 1966 p 63-75 (See N67-15781 06-34) CFSTI: HC $3.00/MF $0.65

Progress conducted under a program designed to develop a general purpose satellite capable of operation at a synchronous altitude with experimental instruments in the areas of meteorology, communications, radiation, navigation, gravity gradient stabilization, and various engineering experiments is reported. Presented are results of efforts to develop a solid propellant rocket motor which will supply the final required velocity increment at the apogee of the elliptical transfer orbit for those satellites to be placed in synchronous orbit. This rocket motor is designated the JPL SR-28-1 (steel chamber) or JPL SR-28-3 (titanium chamber) rocket motor. The JPL SR-28-3 unit is intended for flight use. Discussed are results of static firings of several flightweight motors; visual and physical tests of units after storage, qualification tests, a combination apogee motor-spacecraft test, and tests of the safe and arm ignition system. S.C.W.

N67-15800*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE INTERIOR BALLISTICS OF THE FLUID CONTROLLED SOLID ROCKET MOTOR
O. K. Heiney *In its* Space Programs Sum. No. 37-40, Vol. 4 31 Aug. 1966 p 75-79 ref (See N67-15781 06-34) CFSTI: HC $3.00/MF $0.65

The ballistics of the fluid control motor are derived from the conservation of mass and the equation of state. To completely define the performance of the propellant and injectant selected, the burning rate of the propellant as a function of pressure, and the c^* value as a function of liquid injection is determined. For a given propellant with liquid chlorine trifluoride injection, the theoretical c^* plot is shown for the range of pressures between 50 and 2000 psia. The dynamic responses of fluid controlled motor step change to a lower injection rate and to a higher injection rate are plotted. It is concluded that the fluid control concept is an attractive and feasible method for obtaining a controllable solid rocket motor. However, it is pointed out that the problems of propellant tailoring and suitable injector design require a refined engineering approach. M.G.J.

N67-15847* Avco Corp., Wilmington, Mass. Space and Electronics Group.
RESISTOJET RESEARCH AND DEVELOPMENT PHASE II: DESIGN, DEVELOPMENT AND FABRICATION OF AN AMMONIA-FUELED RESISTOJET THRUSTOR SYSTEM Final Report
Richard R. John Dec. 1966 290 p refs
(Contract NAS3-5908)
(NASA-CR-54688; AVSSD-0356-66-CR) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Details are given on the design, development, and fabrication of an ammonia-fueled resistojet thrustor system for the attitude and orbit control of satellites in the 500- to 1000-lb class. Emphasis was placed on the development of thrustors for operation at the 100- to 1000-micropound thrust level, and for operation at input power levels of the order of 10 W. Details are given on the resistojet engine development, including required engine propulsion performance characteristics; design philosophy; fast heat-up thruster configuration and operating variables; fast heat-up thrustor mass flow, heat transfer, and electrical characteristics; and propulsion performance of the fast heat-up thrustor. Work done on the single axis laboratory attitude control system is reported, emphasizing control logic package, power conditioning package, resistojet engine system, signal conditioning package, and model evaluations. The three axis attitude control and station keeping system is also discussed. L.E.W.

N67-16013*# United Aircraft Corp., East Hartford, Conn.
THEORETICAL INVESTIGATION OF RADIANT HEAT TRANSFER IN THE FUEL REGION OF A GASEOUS NUCLEAR ROCKET ENGINE
A. S. Kesten and N. L. Krascella Washington, NASA, Jan. 1967 32 p refs
(Contract NASw-847)
(NASA-CR-695) CFSTI: HC $3.00/MF $0.65 CSCL 21F

A number of different gaseous nuclear rocket engine concepts have been proposed in which energy is transferred from the fuel to the propellant by thermal radiation: for example, the coaxial-flow reactor and the nuclear light bulb reactor. The temperature distribution in the fuel-containment region of such engines is dependent upon the fuel opacity characteristics. These opacity characteristics can be analytically determined using a heavy-atom model which requires, as a prerequisite, a knowledge of the ionization potentials of the nuclear fuel. To date, two independent theoretical estimates of the first four ionization potentials of uranium have been made. The object of the study described in the following sections is to ascertain the effect of fuel opacity characteristics by using the heavy-atom model and the ionization potentials on the temperature distributions in the fuel-containment region of gaseous nuclear rocket engines. Author

N67-16045*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A THERMODYNAMIC FLOW ANALYSIS OF PARTICLE FORMATION EFFICIENCY IN A MIXED FLOW COLLOID THRUSTOR
Daniel S. Goldin Washington, NASA, 1967 14 p refs Presented at the 5th Aerospace Sci. Meeting, 23–27 Jan. 1967; Sponsored by AIAA
(NASA-TM-X-52265) CFSTI: HC $3.00/MF $0.65 CSCL 21C

The feasibility of adding a coolant gas to the nozzle flow of a colloid thruster to improve the particle formation efficiency is examined. The study is based upon a thermodynamic analysis of the nozzle flow, where a simple physical model is used to describe the energy balance of the condensation process. The noncondensable coolant gas provides an additional heat sink for the latent heat given up during condensation. In cases applicable to colloid thrustors, the analysis indicated maximum efficiencies of about 80% using very optimistic assumptions. The analysis also showed that there is an optimum fractional mass flow of coolant gas that maximizes the particle formation efficiency. Author

N67-16047*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NON-CHEMICAL SPACE PROPULSION
John C. Evvard Washington, NASA, 1967 9 p Presented at the Conf. on Non-Chem. Propulsion, Washington, 12 Jan. 1967; Sponsored by AIAA and Catholic Univ. of Am.
CFSTI: HC $3.00/MF $0.65 CSCL 21H

The technical feasibility and useful mission requirements for an advanced non-chemical space propulsion system are briefly considered. The conventional nuclear rocket to replace the readily-available chemical rocket propulsion is implied, and radiation from the exhaust stream of gas core nuclear rockets is mentioned as a problem area. For planetary colonization purposes, electric propulsion feasibility is cited. Graphs depict: the payload mass fraction, plotted against electric propulsion system specific weight, and also the useful payload that can be achieved with a chemical rocket-electric propulsion hybrid system on a solar probe mission. R.L.I.

N67-16050*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SECONDARY FLOW RATES IN A VERTICAL DIFFUSER OF DECREASING LENGTH USING A ROCKET EXHAUST JET AS THE MOTIVE FLUID
J. Z. Adamson 1 Dec. 1966 18 p
(NASA-TM-X-53543) CFSTI: HC $3.00/MF $0.65 CSCL 21H

This report presents some experimental results obtained from tests with a diffuser of decreasing length and exit area, in which the exhaust jet of a LOX-RP1 rocket engine was used to entrain water into the jet as a liquid coolant. Typical values of pressure and temperature in the diffuser and exhaust duct are presented as a function of the diffuser exit area with the mass ratio of exhaust gas to water as a parameter. Author

N67-16454# Polytechnic Inst. of Brooklyn, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.
RADIATION FROM ROCKET EXHAUST PLUMES
Ralph Zirkind Aug. 1966 35 p refs Presented at the 11th Symp. (Intern.) on Combustion, Berkeley, Calif., 14–20 Aug. 1966
(Contract Nonr-839(34))
(PIBAL-984; AD-641612) CFSTI: HC $3.00/MF $0.65

An attempt is made to present a unified review and evaluation of the current status concerning the emission of optical radiation from rocket exhaust plumes. This topic has been under intensive investigation for various applications since the 1940s and of recent date centered upon the base heating problem. Thus this subject is of serious concern to the engine as well as the vehicle designer. The emission characteristics of rocket exhaust plumes are strongly dependent upon the aerothermochemistry of the plume. The latter, of course, is related to rocket engine parameters and the specific propellant system employed. Conditions created within the exhaust are different for liquid and solid propellants. Notably, the copious amount of large particles in the efflux of metal based solid propellant motors alter the fluid mechanics and radiative transfer of their exhaust plumes and therefore must be taken into account. Author (TAB)

N67-16605*# Martin Co., Denver, Colo.
ADVANCED PRESSURIZATION SYSTEMS FOR CRYOGENIC PROPELLANTS Final Report, 20 Nov. 1963–25 Jun. 1965
J. E. Anderson, O. L. Scott, and H. F. Brady Jan. 1967 298 p refs
(Contract NAS3-2574)
(NASA-CR-54467; Martin-CR-65-75) CFSTI: HC $3.00/MF $0.65 CSCL 21H

The purpose of this program was to select an optimized pressurization system for a vehicle using cryogenic propellants. Improvements in the method of analysis were also developed and incorporated in the program. The vehicle for study was an Apollo-type service module using liquid hydrogen and liquid oxygen as propellants. Systems of both pump-fed and pressure-fed engines were considered during the study with a final selection completed for the pump-fed engine system. Author

N67-16693*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EVALUATION OF HIGH-TEMPERATURE BEARING CAGE MATERIALS
Erwin V. Zaretsky and William J. Anderson Washington, NASA, Jan. 1967 21 p refs
(NASA-TN-D-3821) CFSTI: HC $3.00/MF $0.65 CSCL 13I

A cage compatibility tester was used to determine the relative wear characteristics of six cage materials with four lubricants of practical interest. Test conditions were ambient temperatures of 500° and 700°F, a shaft speed of 1200 rpm, and test durations of from 30 to 120 minutes. Measurements of the wear scar in the cage pocket were used to determine the effect of cage material, temperature, lubricant, and material hardness on cage wear. For the temperature range of 500° to 700°F, S-Monel and M-1 materials gave the least wear. Additionally, at 500°F, 440°C (modified) steel and a polyimide polymer indicated low wear. The best results in terms of low wear were obtained at 500°F with an M-1 material of Rockwell A hardness 81 run with an ester-base lubricant. At 700°F, minimum cage wear was obtained with a polyphenyl ether lubricant and S-Monel material of Rockwell A hardness 67. For a given cage material, cage wear decreased with increased material hardness. This result suggests that cages for high-temperature application should be heat treated to their maximum practical hardness. Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N67-15404# Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.
TERRESTRIAL MAGNETIC FIELD EFFECTS ON AN ELECTROSTATIC ANALYZER

George A. Kuck 1966 44 p
(AFCRL-66-377; AD-640976) CFSTI: HC $3.00/MF $0.65

A uniform magnetic field perturbation of the 1/r coulomb field between the plates of a spherical quadrant electrostatic analyzer was calculated using action-angle variables. The effect of the uniform earths magnetic field on the electrostatic analyzer flown on satellite 1963-25 beta was shown to be negligible for particle energies above 10 keV. For electron energies below 1 keV, the perturbation of the electron trajectories would not be negligible for analyzer plates with a mean radius of 5 cm. Author (TAB)

N67-15486*# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE SOLAR LINE SPECTRUM
V. P. Vyazanitsyn *In its* Phys. of the Solar System, Vol. 3 1966 p 19–36 refs (See N67-15484 06-30) CFSTI: HC $3.00/MF $0.65

The normal solar spectrum, the identification of Fraunhofer lines, equivalent Fraunhofer line widths, and the quantitative composition of the solar atmosphere are considered in a study of the solar line spectrum. Atlases and line catalogs are discussed along with problems in identifying solar lines with the lines of chemical elements. Growth curves are given of the equivalent Fraunhofer line widths, with interest centered on the physical state and structure of the solar atmosphere. Methods of determining the composition of the solar atmosphere are presented as well as some recent determinations of the content of various elements. C.T.C.

N67-15487*# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE STRUCTURE OF THE PHOTOSPHERE: GRANULATION, SUNSPOTS, AND FACULAE
V. A. Krat *In its* Phys. of the Solar System, Vol. 3 1966 p 37–67 refs (See N67-15484 06-30) CFSTI: HC $3.00/MF $0.65

Granulation, sunspots, and faculae are discussed in giving a general appearance of the solar surface. Solar rotation as determined from spots and faculae is described, and the Evershed effect is utilized in considering gas motion in sunspots. Other areas given consideration include the nature of sunspots and the cyclic nature of sunspot formation. C.T.C.

N67-15488*# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE CHROMOSPHERE
V. P. Vyazanitsyn and V. M. Sobolev *In its* Phys. of the Solar System, Vol. 3 1966 p 68–110 refs (See N67-15484 06-30) CFSTI: HC $3.00/MF $0.65

General properties of the chromosphere are discussed with emphasis on observational data obtained just prior to the onset of a total solar eclipse. Consideration is given to spectrophotometric measurements and chromospheric line profiles as well as the chemical composition of the chromosphere. The density distribution of emitting atoms as a function of height is discussed along with the effect of self absorption. Chromospheric models of the temperature and electron concentration are presented; and the jagged structure of the chromosphere, as obtained during solar eclipses, is reviewed. Other areas discussed include the ultraviolet radiation of the chromosphere, the theory of chromospheric heating, and bright flocculi. C.T.C.

N67-15489*# Israel Program for Scientific Translations, Ltd., Jerusalem.
PROMINENCES
V. P. Vyazanitsyn and V. M. Sobolev *In its* Phys. of the Solar System, Vol. 3 1966 p 111–133 refs (See N67-15484 06-30) CFSTI: HC $3.00/MF $0.65

A review is given of prominences which includes observational methods, related physical phenomena, and their relation to bright hydrogen flocculi and sunspots. Statistical data are presented and then used for classification of active, eruptive, sunspot, tornado, quiescent, and coronal prominences. Included are discussions of filaments, spectrophotometric measurements of prominence spectra, and excitation and ionization. C.T.C.

N67-15490*# Israel Program for Scientific Translations, Ltd., Jerusalem.
CHROMOSPHERIC FLARES
V. A. Krat In its Phys. of the Solar System, Vol. 3 1966 p 134–147 refs (See N67-15484 06-30) CFSTI: HC $3.00/MF $0.65

Factual data are presented of chromospheric flares with emphasis on their effects on the ionosphere and the magnetic field of the earth. Consideration is given to the formation of surges, and the spectra of chromospheric flares and their interpretation. Included are discussions of emission cores, and the nature of flares as related to geoactivity. C.T.C.

N67-15491*# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE SOLAR CORONA
V. A. Krat *In its* Phys. of the Solar System, Vol. 3 1966 p 148–168 refs (See N67-15484 06-30) CFSTI: HC $3.00/MF $0.65

Various physical and structural aspects of the solar corona and its processes are discussed. The continuous and line spectra are reviewed along with its brightness and polarization. Structural features of the corona in "white" light are analyzed, and the ionization and excitation of atoms is investigated. Included are discussions involved with the development of coronal condensations, the relation of the corona to the chromosphere, and the problem in coronal theory. C.T.C.

N67-15492*# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE SOLAR SURVEY
M. N. Gnevyshev *In its* Phys. of the Solar System, Vol. 3 1966 p 169–181 refs (See N67-15484 06-30) CFSTI: HC $3.00/MF $0.65

A description is presented of the solar survey which consists of the totality of continuous measurements (taken in a system of observatories) of various phenomena in the solar atmosphere. These phenomena consist of such activity as sunspots, faculae, prominences, and coronal formations. Included are indices of chromospheric solar activity, coronal solar activity, and solar radio emission. C.T.C.

N67-15493*# Israel Program for Scientific Translations, Ltd., Jerusalem.
SOLAR RADIO EMISSION
A. P. Molchanov *In its* Phys. of the Solar System, Vol. 3 1966 p 182–237 refs (See N67-15484 06-30) CFSTI: HC $3.00/MF $0.65

Methods of radio-astronomical observation are discussed and a general description of radio emission is given. Radio emission is separated into undisturbed components, and the characteristics of the components are considered. It is reported that the undisturbed radio component is generally regarded as the thermal emission of the "quiet sun", while disturbed components are closely related to

sunspot formation. The difference between slowly varying disturbed components and rapidly varying disturbed components (radio bursts) is also pointed out. A.G.O.

N67-15499# California Inst. of Tech., Pasadena. Owens Valley Radio Observatory.
NEW DETERMINATIONS OF THE FARADAY ROTATION FOR EXTRAGALACTIC RADIO SOURCES
G. L. Berge and G. A. Seielstad 1966 16 p refs Submitted for Publication *Its* Observations of the Owens Valley Radio Obs. No. 9
(Contracts Nonr-220(19); N00014-67-A0094-0008)
(AD-642106) CFSTI: HC $3.00/MF $0.65

Data are presented on the linear polarization properties of 42 radio sources at 18.0-cm wavelength. These are combined with data obtained previously at other wavelengths to obtain rotation measures. The dependence of all reliable rotation measures on the galactic coordinates is interpreted in terms of the magnetic field within the local spiral arm. Author (TAB)

N67-15739*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ANALYSIS OF MARINER II DATA FOR ALFVEN WAVES
T. W. Unti and M. Neugebauer *In its* Space Programs Sum. No. 37-41, Vol. IV 31 Oct. 1966 p 181-188 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

It is reported that the solar wind appears to support many large and small scale magnetic field fluctuations as indicated by the Mariner II magnetometer data. Relative to this an effort to determine whether some of these variations are plasma waves (Alfvén and/or acoustic) is presented. The formulations are shown, and it is concluded that a simple computer program can be developed to solve the derived equations. Various analysis methods and schemes are suggested for achieving this end. C.T.C.

N67-15900*# Stanford Univ., Calif. Radioscience Lab.
CISLUNAR ELECTRON CONTENT AS DETERMINED BY RADAR GROUP DELAY MEASUREMENTS
H. T. Howard Nov. 1966 27 p refs
(Grant NsG-377)
(NASA-CR-81279; SEL-66-113; SR-17) CFSTI: HC $3.00/MF $0.65 CSCL 20H

The 25 and 50 MHz radars were modified to improve power output and time resolution and, through the months of July and August, 1965, were used to determine cislunar electron content during 55 lunar meridian transits. Ionospheric electron contents, determined by the Faraday rotation on 136 MHz signals from Syncom III, were combined with calculated protonospheric values and subtracted from each radar determination of total content. The results reinforce the earlier conclusion that there are two distinct regions beyond the plasmasphere. In the general direction of the sun where most of the radar path is beyond the shock wave boundary, the avarage electron number density is very low: 11 ± 30 cm^{-3}. Within the solar wind wake of the earth, in the quadrant opposite the sun, the columnar content from approximately 4 R_E to the moon is $4.9 \pm 1.2 \times 10^{18}$ electrons m^{-2}. If this content were spread evenly along the path, it would imply a number density of 120 ± 30 cm^{-3}. The wake density and possibly its shape appear to change on a day to day basis. Author

N67-16028*# Naval Research Lab., Washington, D. C.
EXPERIMENT D-14, UHF-VHF POLARIZATION
Robert E. Ellis *In* NASA, Washington Manned Space-Flight Expt., Gemini IX Mission 1 Nov. 1966 p 97-127 (See N67-16021 06-30) CFSTI: HC $3.00/MF $0.65

A VHF-UHF Faraday rotation experiment (D-14) was conducted in conjunction with the Gemini IX spacecraft transits over Kauai, Hawaii, and Antigua, British West Indies. Although the signal-to-noise ratio was lower than anticipated, preliminary analysis indicates that no problem should be encountered in detecting ionospheric inhomogeneities of the order of 1 kilometer in horizontal scale, provided that the excursions exceed 1 percent of the subsatellite electron content. Ambiguity removal has been accomplished by comparing the orientation of the VHF and the UHF polarization ellipses. Values of the electron content and the effective slab thickness have been determined at the closest point of approach for three of the five Kauai transits. It is apparent that the subsatellite content increases with increasing F2 region electron density; however, the occurrence of slab thickness variations implies that the relationship is not a simple one. Author

N67-16359# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
DIFFUSION MODEL OF LOW ENERGY CHARGED PARTICLES ALONG OPEN FIELD LINES
Joseph M. Grebowsky 30 Jul. 1966 40 p refs
(Contract AF 19(628)-4014; Grant NSF GP-5811)
(AFCRL-66-671; SR-277; AD-641204) CFSTI: HC $3.00/MF $0.65

Just after dayside connection of the field lines, there is a discontinuity in charged particle densities which yields a negative potential on the interplanetary side. The electrons travel a distance comparable to the size of the magnetosphere in a few minutes--a time much smaller than the period of the field line circulation. Thus the electrons can be treated independently of time. However, a time dependent study of the proton motions must be considered. Using a step function for the proton distribution of velocities, the magnitude of the electric field potential determined from quasineutrality is of the order of volts. The resulting potential profile implies that some electrons will be trapped between the low altitude magnetic mirror and an electric potential wall as the field line travels toward the nightside. It also appears that spikes in electron density propagate away from the initial discontinuity. Author (TAB)

N67-16505*# Consultants and Designers, Inc., Arlington, Va.
THE OUTERMOST BELT OF CHARGED PARTICLES [SAMYY VNESHNIY POYAS ZARYAZHENNYKH CHASTITS]
K. I. Gringauz and M. Z. Khokhlov 17 Nov. 1965 24 p refs Transl. into ENGLISH from Issl. Kosmich. Prostranstva Tr. Vsesoyuznoy Konf. Po Kosmich. Lucham (Moscow), Jun. 1965 p 467-482
(Contract NAS5-3760)
(NASA-CR-81276; ST-PF-GM-10413) CFSTI: HC $3.00/MF $0.65 CSCL 20H

The zone of charged particles with comparatively low energies situated beyond the outer radiation belt is discussed. The space probes on which data on soft electrons and protons were obtained are considered, and examples of registration of soft electrons at high geomagnetic latitudes by Mars-1 and Electron-2 are reviewed. It is shown that here, as in other space probes, the zones of soft electron fluxes are partly overlapping with the zones of trapped radiation. The spatial distribution of fluxes of soft electrons is studied in light of data obtained from various space probes for the daytime region along the magnetosphere boundary from the sunny side. The night region of fluxes is also examined. The essentially new revelation of the magneto-neutral layer on the night side is discussed. Brief consideration is given to the origin of soft electrons and the importance of the outermost zone of charged particles from the geophysical standpoint is emphasized. S.P.

N67-16507*# Consultants and Designers, Inc., Arlington, Va.
ON THE COULOMB RELAXATION PROCESS OF FAST PARTICLES DISTRIBUTION IN THE EARTH'S RADIATION BELTS [O PROTSESSE KULONOVSKOY RELAKSATSII RASPREDE EVIYA BYSTRYKH CHASTITS V RADIATSIONNYKH POYASAKH ZEMLI]
G. A. Timofeyev 10 Nov. 1965 6 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 5, no. 4, 1965, p 754–756
(Contract NAS5-3760)
(NASA-CR-81275; ST-PF-10410) CFSTI: HC $3.00/MF $0.65 CSCL 20H

This note deals with the question of the time variation in the distribution of fast electrons or ions in radiation belts at the expense of their Coulomb interaction with the medium. The starting point is the kinetic equation where account is taken of the Coulomb interactions of fast particles with a cold plasma, leading to small variations of energy and pulse in the elementary event. The results of calculations show that electrons with reflection points at 350 and 500 km diffuse rapidly into the dense atmosphere layers, hardly losing their energy, their diffusion times being respectively about $3 \cdot 10^3$ and $1 \cdot 10^4$ sec. Author

N67-16508*# Volt Technical Corp., Washington, D. C.
THE BEHAVIOR OF PARTICLES OF RADIATION BELTS DURING MAGNETIC STORMS [O POVEDENIY CHASTITS RADIATSIONNYKH POYASOV VO VREMYA MAGNITNYKH BUR']
V. P. Shabanskiy 14 Oct. 1966 12 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 6, no. 3, 1966 p 479–485
(Contract NAS5-12487)
(NASA-CR-81271; ST-PF-GM-10518) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Radial displacement of particles in radiation belts induced by universal magnetic storms are considered. The source of the disturbance lies in the ring current within the magnetosphere and in the current at the magnetosphere boundary, created by the solar wind. Only the first harmonic (uniform component) of the disturbance field is taken into account from the first source. For the majority of the particles of the fields, this leads to reversible displacements. Particles with reflection points, low-disposed above the ground, in the process of radial transition of shells, may be lowered into the dense layers of the atmosphere and dumped. The concrete examples of the storms of 12 and 20 February 1964 are examined. Author

N67-16511*# Avco-Everett Research Lab., Everett, Mass.
VAN ALLEN BELT PLASMA PHYSICS
C. F. Kennel and H. E. Petschek Dec. 1966 84 p refs
(Contracts NASw-1400; AF 49(638)-1483)
(NASA-CR-81257; Avco-Everett Res. Rept.-259) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Recent theoretical developments in understanding the plasma turbulence in the Van Allen belts are reviewed. More complex geophysical turbulence phenomena, such as the auroral zone, are not explicitly treated, since their theoretical description is still incomplete. In particular, it now appears likely that instability, and the resulting quasilinear pitch angle scattering, in the so-called whistler and ion cyclotron modes, limits the fluxes of energetic electrons and ions, respectively, that can be stably trapped in the Van Allen belts, where the Earth's magnetic lines have a dipole mirror configuration. We discuss semiquantitatively the factors which affect the stability of such waves propagating obliquely to the local magnetic field direction, the velocity space diffusion resulting from their nonlinear growth, and finally, some observations relating to the Van Allen belt turbulence. Author

N67-16518* Consultants and Designers, Inc., Arlington, Va.
CONTROL OF COSMIC RADIATION LEVEL DURING THE FLIGHT OF SPACESHIPS "VOSTOK-3, VOSTOK-4, VOSTOK-5, VOSTOK-6" [KONTROL' ZA UROVNEM KOSMICHESKOY RADIATSII NO VREMYA POLETA KOSMI CHESKIKH KORABLEY "VOSTOK-3, VOSTOK-4, VOSTOK-5, VOSTOK-6"]
I. A. Savenko, N. F. Pisarenko, P. I. Shavrin, and V. E. Nesterov 2 Jun. 1965 8 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. III: Fiz. Astron. (Moscow), no. 2, 1965 p 40–43
(Contract NAS5-3760)
(NASA-CR-81273; ST-CR-RD-10342) CFSTI: HC $3.00/MF $0.65 CSCL 20H

The conditions created by radiation effects in flight of spaceships Vostok-3, -4, -5 and -6 are described, after review of results obtained during the flight of earlier Vostoks. Prior to and during these earlier flights, a special group observed the solar activity from the ground, along with cosmic radiosondes studying the cosmic radiation in the upper atmosphere layers. Special research was conducted to evaluate the effects at appropriate levels of the Johnson Island nuclear explosion in height, and thus smooth out the earlier contradictory information. This was mainly done by Cosmos-7. Author

N67-16622* Consultants and Designers, Inc., Arlington, Va.
EJECTIONS IN THE SOLAR ATMOSPHERE [VYBROSY V SOLNECHNOY ATMOSFERE]
S. O. Obashev 8 Sep. 1965 8 p refs Transl. into ENGLISH from Dokl. Acad. Nauk SSSR, Ser. Astron. (USSR), v. 163, no. 3, 1965 p 599–602
(Contract NAS5-3760)
(NASA-TT-F-9697; ST-SP-10380) CFSTI: HC $3.00 CSCL 20H

Telescopic observations of a characteristic solar ejection were made at a solar observatory. Presented and discussed in this paper are height variations of the ejection, an estimate of the total number of hydrogen atoms in the limb ejection, a calculation of the energy emission, and a comparison of the mass of ejection gases with that of the chromosphere. Illustrations are included of the ejection on the disk v and of the development of a flare and of an emissive ejection on the limb. K.W.

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N67-15400*# Arizona Univ., Tucson.
COMMUNICATIONS OF THE LUNAR AND PLANETARY LABORATORY, NOS. 58–59
1966 80 p refs *Its* Vol. 4, Pt. 1
(Grant NsG-161)
(NASA-CR-81160) CFSTI: HC $3.00/MF $0.65 CSCL 03A

An attempt is made to interpret the Range VII photographs and to assess their impact on lunar science. First, a classification is presented of the lunar maria based on their gross structure as found from Earth-based photography. Mare Cognitum is seen to be an impact mare, its basin having been formed well before that of Mare Imbrium. The vertical structure of the maria in general at the intermediate scale is discussed based on photography at very low Sun angles and on color photography with a wide base line. Next results concerning the presence or absence of a cosmic dust layer are considered. From high-resolution color photography it is concluded that no such layer covers the Moon, although the

uppermost meter or more has undoubtedly been contaminated with cosmic debris. Data on lunar craters, crater rays, and the physical and mechanical structure of upper layers of the mare floor are reviewed. S.P.

N67-15417# California Inst. of Tech., Pasadena. Owens Valley Radio Observatory.
MEASUREMENTS OF THE FLUX DENSITIES, POSITIONS AND ANGULAR WIDTHS OF PLANETARY NEBULAE AT 10 CM AND 21 CM WAVELENGTHS
G. J. Stanley, A. R. Thompson, and R. S. Colvin (Stanford Univ.) 1966 20 p refs *Its* Observation No. 8 Submitted for Publication
(Contract Nonr-220(19))
(AD-642165) CFSTI: HC $3.00/MF $0.65

Observations of 36 planetary and two diffuse nebulae have been made using the two 90-ft diameter antennas. The effects of confusion with non-thermal radio sources were examined statistically. In addition some indication of the nebulae for which confusion is most serious was obtained from a comparison of the radio positions with optical positions. Errors in the flux density measurements resulting from confusion should be small at 10 cm but are more serious at 21 cm. Angular widths of 29 of the nebulae were measured at 10 cm using spacings of 2351 and 4701 wavelengths east-west. The radio widths are in agreement with optical widths for approximately 80% of the nebulae, and in the remaining cases it appears probable that the discrepancies are an indication of confusion or of uncertainties in the optical data rather than non-thermal emission. The ratios of the measured radio and H beta flux densities of the nebulae show general agreement with the theoretical ratio for thermal emission, and discrepancies result most probably from errors in the estimated H beta absorption. Author (TAB)

N67-15429*# Israel Program for Scientific Translations, Ltd., Jerusalem.
MOTION OF AN ARTIFICIAL SATELLITE ABOUT ITS CENTER OF MASS
V. V. Beletskii 1966 272 p refs Transl. into ENGLISH of the book "Dvizhenie Iskusstvennogo Sputnika Otnositel No Tsentra Mass" Moscow, Izd. Nauka, 1965 Published for NASA and NSF
(NASA-TT-F-429; TT-67-51366) CFSTI: HC $3.00/MF $0.65 CSCL 22A

For geophysical and dynamical space research application, the rotational motion of artificial space vehicles is evaluated. It is shown how motion about the center of mass affects the mean aerodynamic drag coefficient, orbital parameters, and electromagnetic and aerodynamic torques. Discussed analytically are such problems as: effect of aerodynamic torque on satellite librations, gravity attitude stabilization of artificial satellites, the relation between the translational and the rotational motions of a satellite in a Newtonian force field, perturbed motions in relation to orbit evolution due to the Earth's flattening, determination of mean drag coefficient and its dependence on satellite attitude, the insolation of instruments in a satellite oriented with respect to the Earth, motion of a rigid body around a fixed point in a Newtonian force field, and motion of an equatorial Earth satellite. Numerous graphs and mathematical expressions complete the analytical data. R.Ll.

N67-15441*# Israel Program for Scientific Translations, Ltd., Jerusalem.
PHYSICS OF COMETS AND METEORS
V. P. Konopleva, ed 1966 110 p refs Transl. into ENGLISH of THE BOOK "Fizika Komet i Meteorov" Kiev, Izd. Naukova Dumka, 1965 Published for NASA and NSF
(NASA-TT-F-340; TT-67-51213) CFSTI: HC $3.00/MF $0.65 CSCL 03B

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13. TURBULENT MOTIONS IN THE UPPER ATMOSPHERE AT HEIGHTS OF 80–110 km ACCORDING TO RADIO OBSERVATIONS OF METEOR TRAINS I. A. Delov p 81–90 refs (See N67-15454 06-13)

N67-15442*# Israel Program for Scientific Translations, Ltd., Jerusalem.
PHOTOMETRY OF COMETS USING 1963–1964 PATROL PHOTOGRAPHS
D. A. Rozhkovskii *In its* Phys. of Comets and Meteors 1966 p 1–14 refs (See N67-15441 06-30) CFSTI: HC $3.00/MF $0.65

The patrol program for observation of weak comets and techniques of photographic photometry are considered. The current method of photographic observation is presented, and an alternative setup is proposed. In this setup the moving stage of a microphotometer is equipped with a small round table with a central hole where a precision bearing is fitted to ensure smooth and rapid rotation of the negative in the course of measurements. Results of photographs of objects whose apparent structure was suitable for revolving-table photometry are presented. The luminosity of the comet's dust envelope is considered, and used to evaluate the space distribution of volume density in comets. S.P.

N67-15443*# Israel Program for Scientific Translations, Ltd., Jerusalem.
DETAILED PHOTOMETRY OF COMET AREND–ROLAND 1956 h
G. K. Nazarchuk *In its* Phys. of Comets and Meteors 1966 p 15–24 refs (See N67-15441 06-30) CFSTI: HC $3.00/MF $0.65

Negatives were selected from a series of photographic observations of comet 1956 h (Arend–Roland) for detailed photometry. The photographs were standardized by the method of extrafocal stellar images, and red stars lying near the center of the plate were applied. The distortion factors of photometric field error, background illumination, and differential absorption of light in the atmosphere are considered. After correction for these factors, the brightness distribution along the streams and along the radius-vector is plotted. The decrease of brightness along the streams is a joint contribution of several factors: lateral dissipation of matter, acceleration of particles, finite lifetime of optically emitting particles. Observational data are compared with simplified theoretical models. Finally the estimates of corpuscular stream parameters are made. S.P.

N67-15444*# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE RADIUS OF EXISTENCE OF C_2 AND C_3 MOLECULES IN COMETS
V. I. Cherednichenko *In its* Phys. of Comets and Meteors 1966 p 25–30 refs (See N67-15441 06-30) CFSTI: HC $3.00/MF $0.65

The subject of C_2 and C_3 molecules produced by molecules of acetylene and propylene participating in various reactions in the heads of comets is discussed. Calculations are presented for the radius of existence of C_2 and C_3 molecules in the field of photon and corpuscular radiation of the sun, comparing theoretical results with the radii observed in the head of Halley's comet 1910 II. Further consideration is given to the agreement between the calculated data for the molecules C_3H_8 and C_2H_2 and the observed variation in the head diameter of Halley's comet with the distance from the sun. S.P.

N67-15445*# Israel Program for Scientific Translations, Ltd., Jerusalem.
DISSOCIATION AND IONIZATION OF WATER MOLECULES IN COMETARY ATMOSPHERES
V. I. Cherednichenko *In its* Phys. of Comets and Meteors 1966 p 31–34 refs (See N67-15441 06-30) CFSTI: HC $3.00/MF $0.65

Data are presented for the ionization and dissociation processes of H_2O molecules. The effective photoabsorption cross sections of the various reactions with the participation of water molecules and the corresponding lifetimes in the field of corpuscular solar radiation are calculated. The reactions of H_2O in the field of solar photons for comets at a distance of $r = 1$ A.U. from the sun are tabulated. Data are also presented for the corpuscular conversions of H_2O molecules produced by solar protons in the corpuscular streams. S.P.

N67-15446*# Israel Program for Scientific Translations, Ltd., Jerusalem.
INTRINSIC BRIGHTNESS OF COMET IKEYA 1963 A
S. K. Vsekhsvyatskii *In its* Phys. of Comets and Meteors 1966 p 35 (See N67-15441 06-30) CFSTI: HC $3.00/MF $0.65

The comet Ikeya 1963 a was discovered in the evening twilight with binoculars, according to Marsden's ephemerides, at a height of 15° above the horizon. The intrinsic brightness of the comet was estimated with binoculars by means of extrafocal comparison with nearby stars. The brightness in stellar magnitudes is given and the comparison stars are tabulated. S.P.

N67-15447*# Israel Program for Scientific Translations, Ltd., Jerusalem.
VISUAL OBSERVATIONS OF COMET ALCOCK 1963 B
S. K. Vsekhsvyatskii *In its* Phys. of Comets and Meteors 1966 p 36–38 (See N67-15441 06-30) CFSTI: HC $3.00/MF $0.65

A list of observations concerning the intrinsic brightness of the comet Alcock 1963 b is presented. All estimates were obtained by extrafocal comparison with other stars. The comet's brightness in stellar magnitudes is given, and magnitudes of the comparison stars are tabulated. S.P.

N67-15448*# Israel Program for Scientific Translations, Ltd., Jerusalem.
STATISTICAL CHARACTERISTICS OF THE METEOR RADIO ECHO IN THE EPOCH OF THE 1963 GEMINIDS
E. I. Fialko, I. V. Bairachenko, Yu. V. Chumak, R. I. Moisya, and V. I. Mel'nik *In its* Phys. of Comets and Meteors 1966 p 39–44 refs (See N67-15441 06-30) CFSTI: HC $3.00/MF $0.65

Observations were made in the epoch of the Geminid stream using radar equipment, and statistical characteristics of the meteor radio echo were determined. The statistical characteristics were derived from determination of the slant range, the time of occurrence, and the duration, as well as the radio echo amplitudes. Some of the conclusions noted were: (a) three echo types distinctly emerge from the echo amplitude distribution—stable, unstable, and intermediate, (b) the distribution of the intermediate radio echoes is closer to the stable echoes, and (c) the time distribution of meteor echoes is exponential. S.P.

N67-15449*# Israel Program for Scientific Translations, Ltd., Jerusalem.
SOME RESULTS OF THE APPLICATION OF INTERMEDIATE-TYPE TRAINS IN MEASUREMENTS OF ELECTRON LINE DENSITY
E. I. Fialko, I. V. Bairachenko, and Yu. V. Chumak *In its* Phys. of Comets and Meteors 1966 p 45–46 refs (See N67-15441 06-30) CFSTI: HC $3.00/MF $0.65

A radio echo technique for measuring the electron line density α in ionization trains of the intermediate type is applied to obtain the distribution of α in the range $\alpha \approx 10^{12}$–5.10^{12} electron/cm. Experimental data from 1963 Geminid observation were used. A graphical presentation illustrates the integrated distribution of the electron line density α in intermediate-type trains. S.P.

N67-15450*# Israel Program for Scientific Translations, Ltd., Jerusalem.
PROPAGATION OF ELECTROMAGNETIC WAVES IN A MOVING GYROTROPIC MEDIUM
I. A. Deryugin and V. I. Vorontsov *In its* Phys. of Comets and Meteors 1966 p 47–56 refs (See N67-15441 06-30) CFSTI: HC $3.00/MF $0.65

A theory is advanced for the propagation of plane, and in general inhomogeneous, electromagnetic waves in a moving gyrotropic medium. The nonmagnetized moving plasma is considered as a particular case of the theory. Linear equations are presented for the components of a variable electromagnetic field. Then the equation of normals for longitudinally moving gyrotropic media is given, and finally circularly polarized tranverse electromagnetic waves are introduced. S.P.

N67-15451*# Israel Program for Scientific Translations, Ltd., Jerusalem.
THE DRIFT OF METEOR TRAINS
B. L. Kashcheev *In its* Phys. of Comets and Meteors 1966 p 57–61 refs (See N67-15441 06-30) CFSTI: HC $3.00/MF $0.65

The drift of meteor trains was systematically measured by the coherent-pulse technique at a frequency of 36.9 Mc/s. Radio reflections from the ionization trains were photographed. Individual values of the zonal component and 79,536 values of the meridianal component were obtained. A distinct 12-hour (semidiurnal) component with an amplitude of ≈10—30 m/sec was observed on every single day. The enormous (relative to ground conditions) amplitude of the 12-hour component in the meteor zone may be attributed to resonance oscillations produced by the sun. S.P.

N67-15452*# Israel Program for Scientific Translations, Ltd., Jerusalem.

SOME PROBLEMS OF THE THEORY AND NEW METHODS OF OBSERVATION OF METEORS

E. N. Kramer *In its* Phys. of Comets and Meteors 1966 p 62–74 refs (See N67-15441 06-30) CFSTI: HC $3.00/MF $0.65

The nature and distribution of meteor matter, whose origin is connected with comets, are considered with respect to meteor fragmentation. A criterion for meteor fragmentation is discussed and fundamental equations are presented for the physical theory of meteors. A shortcoming of the modern methods of meteor photography is listed as the capability of the negative to show the trail produced by a flying meteor, but not the meteor itself. Requirements are stated for application of the method of instantaneous exposure in meteor photography. Investigations of meteor-cometary reactions are presented in connection with astronautics and meteor hazards of interplanetary space. Accompanying tables list the heliocentric coordinates for the nodes of all the cometary orbits meeting the plane of the ecliptic at distances of from 0.5 to 2 A.U. A list of periodic comets is included as a cross reference. S.P.

N67-15453*# Israel Program for Scientific Translations, Ltd., Jerusalem.

ON THE SUBJECT OF THE TRAJECTORY AND THE ORBIT OF THE TUNGUSKA COMET

I. S. Astapovich *In its* Phys. of Comets and Meteors 1966 p 75–80 refs (See N67-15441 06-30) CFSTI: HC $3.00/MF $0.65

Data are presented for determining the azimuth of projection of a comet's atmospheric trajectory and its inclination to the horizontal plane. Attempts are made to give the radiant position in the equatorial system and, in the final analysis, the direction of the tangent to the comet's orbit at that time. A few of the observations pertaining to the position of the apparent trajectory are tabulated, and the point of the trajectory that appeared to be projected on the solar disk in various locations is derived. The inclination is estimated independently on the basis of the difference between the heights of appearance and disappearance of the fireball and the length of the apparent path. S.P.

N67-15463*# Israel Program for Scientific Translations, Ltd., Jerusalem.

CORRELATION BETWEEN IMAGE PULSATIONS OF STARS AT A SMALL ANGULAR DISTANCE FROM EACH OTHER

I. G. Kolchinskii *In its* Opt. Instability of the Earth's Atmosphere 1966 p 7–19 refs (See N67-15461 06-13) CFSTI: HC $3.00/MF $0.65

The correlation function for the pulsation of two stars at small angular distance from each other was calculated and compared with observational results from measurements of Pleiades trails as photographed by 400-m astrograph. The problem was reduced to the computation of the correlation coefficient between the difference of phase fluctuations in two pairs of parallel beams which made a small angle with the telescope objective and it was assumed that the refractive index fluctuated mainly due to temperature variations. Results indicated that the correlation between image pulsations of two components of a binary separated by an angle was higher for small zenith distances than for large zenith distances and induced rapid deterioration of the resolving power. The fit between observed and calculated values was satisfactory; the observed curve departed somewhat from the theoretical line in the direction of low-frequency pulsations. G.G.

N67-15464*# Israel Program for Scientific Translations, Ltd., Jerusalem.

BEADING OF STAR TRAILS

I. G. Kolchinskii *In its* Opt. Instability of the Earth's Atmosphere 1966 p 20–25 refs (See N67-15461 06-13) CFSTI: HC $3.00/MF $0.65

The trails of moving stars photographed through a fixed tube of an astrograph often reveal so-called beading. The trail density is not uniform, and the trail seems to be made up from individual nodules which are much darker than the rest of the image. The distance between these nodules is approximately constant along the trail. The beads are mostly set against a continuous background of the principal trail, but in some cases the trail may break into isolated beads, the gaps showing hardly any perceptible darkening. Trail beading was often commented upon by observers of double stars, since in photographic observations of binaries the trails are applied to improve plate setting. Measurements of trails taken with the Moscow Observatory large astrograph gave τ = 0^{s}3 as the mean time interval between successive beads. For the wide-angle astrograph this interval was 0^{s}37, and for the coronograph 0^{s}34. Author

N67-15466*# Israel Program for Scientific Translations, Ltd., Jerusalem.

THE EFFECT OF ATMOSPHERIC TURBULENCE ON IMAGES OF EXTENDED CELESTIAL SOURCES

N. V. Bystrova and A. N. Demidova *In its* Opt. Instability of the Earth's Atmosphere 1966 p 31–32 refs (See N67-15461 06-13) CFSTI: HC $3.00/MF $0.65

Simultaneous observations of lunar limb deformation and of the schlieren pattern of stars were made. The results showed that the atmospheric inhomogeneities responsible for both these phenomena were located at the same altitude /6/. This implies that the scintillation of stars is produced by the same atmospheric layer which causes directional displacement of deformations in the image of the lunar limb. Author

N67-15472*# Israel Program for Scientific Translations, Ltd., Jerusalem.

SCINTILLATION OBSERVATIONS BY THE PULKOVO OBSERVATORY EXPEDITIONS IN THE YEAR 1956–1960

Sh. P. Darchiya *In its* Opt. Instability of the Earth's Atmosphere 1966 p 82–90 refs (See N67-15461 06-13) CFSTI: HC $3.00/MF $0.65

Preliminary observational results on star scintillations over a number of years are presented. Stars were observed at various U.S.S.R. sites at differing zenith distances and azimuths, as well as during differing night times. Stellar brightness fluctuations were recorded by telescope equipped with an electrophotometer and oscillograph. Scintillation frequencies were determined by counting the intersection points of the scintillation recording with the mean recording level in 5 seconds and by reducing the count to 1 second. It was found that the number of intersection points decreased with increasing zenith; a large difference in the dependence of the maximum scintillation amplitude on the zenith for areas differing in elevation above sea level and in topographic and climatic conditions were found. G.G.

N67-15476*# Israel Program for Scientific Translations, Ltd., Jerusalem.

OBSERVATION OF IMAGE PULSATION IN THE SANGLOK AREA (TADZHIKISTAN) IN SUMMER 1960

N. M. Bronnikova *In its* Opt. Instability of the Earth's Atmosphere 1966 p 117–122 (See N67-15461 06-13) CFSTI: HC $3.00/MF $0.65

Star trails were photographed during summer 1960 for various zenith distances at 10-m telescope focus when its driving mechanism was stopped. Thirty-one negatives with 157 star trails were obtained and their image quality was estimated according to the Danjon–Couder scale in parallel with photographic observations. Plots of the rms pulsation amplitude distribution for each trail showed a certain systematic variation of slope from evening to morning, when the distribution of the rms pulsation amplitude was not linear. Atmospheric transparency seemed to deteriorate nearly always when the distribution of the rms pulsation amplitude was nonlinear. No correlation was found between the rms pulsation amplitude and the shimmer angle reduced to zenith, whereas a certain correlation was established with a horizontal shimmer angle. It was concluded that the zenith values of the shimmer disk and of star image pulsation should be measured directly at the zenith. G.G.

N67-15478*# Israel Program for Scientific Translations, Ltd., Jerusalem.

A PHOTOELECTRIC METHOD OF IMAGE PULSATION RECORDING AND SOME RESULTS OF OBSERVATIONS

I. P. Rozhnova *In its* Opt. Instability of the Earth's Atmosphere 1966 p 139–144 refs (See N67-15461 06-13) CFSTI: HC $3.00/MF $0.65

A block diagram, illustrating photoelectric recordings of star image pulsations, is described that employs two photomultipliers coupled into a bridge network to reflect equal luminous fluxes from a prism if the star image lies precisely on the optical axis. A shift of star image in either direction from the telescope's optical axis due to atmospheric turbulence produces bridge imbalance proportional to the displacement of the star image relative to the prism edge. This imbalance voltage is a function of image pulsation for frequencies of up to $f \cong 10^3$ c/s. Pulsation oscillograms of Polaris, Jupiter, and α Bootis are shown and demonstrate the fact that planets pulsate without scintillating. Jupiter pulsated only in poor visibility nights at large zenith distances. G.G.

N67-15484*# Israel Program for Scientific Translations, Ltd., Jerusalem.

PHYSICS OF THE SOLAR SYSTEM, VOLUME 3

A. A. Mikhailov, ed. 1966 398 p refs Transl. into ENGLISH of the book "Kurs Astrofiziki i Zvezdnoi Astronomii" Moscow, Izd. Nauk, 1964 Published for NASA and NSF

(NASA-TT-F-342; TT-66-51022) CFSTI: HC $3.00/MF $0.65 CSCL 03B

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N67-15485*# Israel Program for Scientific Translations, Ltd., Jerusalem.

THE SUN: INTRODUCTION

V. P. Vyazanitsyn *In its* Phys. of the Solar System, Vol. 3 1966 p 3–18 refs (See N67-15484 06-30) CFSTI: HC $3.00/MF $0.65

Processes occurring on the surface of the sun are discussed, with emphasis on observational results and their interpretation. It is pointed out that this solar activity has a direct bearing on various geophysical problems: on changes in the magnetic field and ionosphere of the earth, on the influence which solar phenomena have on weather and climate, and on other related questions. Various facts are presented in discussing such areas as total solar radiation, fluctuations in solar radiation, the energy distribution in the solar spectrum, limb darkening, and solar rotation. C.T.C.

N67-15494*# Israel Program for Scientific Translations, Ltd., Jerusalem.

THE MOON

A. V. Markov *In its* Phys. of the Solar System, Vol. 3 1966 p 238–263 refs (See N67-15484 06-30) CFSTI: HC $3.00/MF $0.65

The nature of the lunar surface is studied from the standpoint of the prospective landing of men on the Moon. It is noted that the lunar surface is quite different from the surfaces of all the planets in the solar system except Mercury. Photometric and polarization properties of the highly irregular lunar topography are considered, and studies of the lunar crust temperatures using heat receivers and radio methods are described. Endogenous and exogenous hypotheses of lunar relief formation are explained, and data on the structure of the other side of the Moon obtained from rocket flights are reported. A.G.O.

N67-15495*# Israel Program for Scientific Translations, Ltd., Jerusalem.

PHYSICS OF THE PLANETS

V. V. Sharonov *In its* Phys. of the Solar System, Vol. 3 1966 p 264–298 (See N67-15484 06-30) CFSTI: HC $3.00/MF $0.65

Methods of physical research on the planets and satellites are considered. Studies based on photometric measurements of various kinds, which are then analyzed to obtain the absolute reflectivities for different spectral regions, the relative angular distribution of the reflected flux, and also data on the polarization of spectral composition of the reflected light, are discussed. The reliability of results obtained by radiometric measurements in the far infrared are mentioned, and it is pointed out that a proper

interpretation of these data gives the surface temperatures of the planet and satellites. Classical information obtained by astronomical observations and celestial-mechanical computations, however, still constitutes the most valuable and reliable data available to the planetologist. Such classical data are the sizes, figures, masses, rotation elements, catographic and topographic material, and mean densities of the planets. A.G.O.

N67-15496*# Israel Program for Scientific Translations, Ltd., Jerusalem.
A DESCRIPTION OF INDIVIDUAL PLANETS
V. V. Sharonov *In its* Phys. of the Solar System, Vol. 3 1966 p 299–327 refs (See N67-15484 06-30) CFSTI: HC $3.00/MF $0.65

General descriptions are given of the nine planets and thirty-one satellites known in the solar system. Consideration is given to surface structures, color, atmospheric composition, origin, size and mass, temperature conditions, planetary disks, and absorption spectrums of the individual planets. Methods for observing planetary characteristics and obtaining property data are also discussed. A.G.O.

N67-15497*# Israel Program for Scientific Translations, Ltd., Jerusalem.
PHYSICAL PROPERTIES OF THE MINOR PLANETS
A. V. Markov *In its* Phys. of the Solar System, Vol. 3 1966 p 328–335 refs (See N67-15484 06-30) CFSTI: HC $3.00/MF $0.65

Orbits, physical properties, and the origin of the minor planets (also called asteroids) are discussed. The asteroids are classified among the minor bodies of the solar system which includes comets, meteorites, and meteoritic dust. It is emphasized that studies of the physical characteristics of the minor planets are of enormous significance in explaining their properties and origin. Characteristics such as angular dimension, diameter, stellar magnitude, albedo, color index, and phase coefficient are presented. A.G.O.

N67-15498*# Israel Program for Scientific Translations, Ltd., Jerusalem.
COMETS, METEORS AND THE ZODIACAL LIGHT
O. V. Dobrovol'skii *In its* Phys. of the Solar System, Vol. 3 1966 p 336–391 refs (See N67-15484 06-30) CFSTI: HC $3.00/MF $0.65

General data on the appearance of comets are discussed, and characteristics such as cometary nuclei, cometary spectra, the apparent brightness of a comet, and masses and densities of cometary atmospheres are considered. Differentiation of matter in a cometary atmosphere under the influence of solar heat is explained, and the origin of comets are mentioned. The combination of phenomena in the earth's atmosphere which accompanies the flight of a meteoric body, elements of the physical theory of meteors, results of photographic observations of meteors, spectra of meteors, and the characteristics and nature of zodiacal lights are also covered. A.G.O.

N67-15667*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
RONDVU/PRESTO–PROGRAM FOR RENDEZVOUS MISSION TRAJECTORY OPTIMIZATION
Richard C. Rosenbaum, Robert E. Willwerth, Jr., and Richard L. Moll Washington, NASA, Jan. 1967 42 p
(Contract NAS1-5255)
(NASA-CR-685) CFSTI: HC $3.00/MF $0.65 CSCL 22C

This report presents documentation for the addition of an orbital rendezvous option to the trajectory optimization program known as Presto Version Delta. This option provides a program capability of determining boost to rendezvous trajectories with a moving target of specified ephemeris such that the time and location of the rendezvous will be optimized simultaneously with the boost trajectory shaping. Rendezvous occurs when the booster and the target have identical position and velocity vectors. Author

N67-15675* Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
A DIFFUSION MODEL CALCULATION OF THE VARIATIONS PRODUCED IN THE LUNAR ATMOSPHERE BY THE LUNAR MODULE EXHAUST
S. N. Milford and F. R. Pomilla Nov. 1966 70 p refs
(Contract NAS9-4860)
(NASA-CR-65573; RE-271) CFSTI: HC $3.00/MF $0.65 CSCL 22A

A two two-dimensional diffusion model is developed to study the spread of the exhaust contaminants from the Lunar Module (LM) into the lunar atmosphere. The rarefied ambient lunar atmosphere is treated as an exosphere. The model assumes that the exhaust gas molecules diffuse along the surface as a result of collisions with the surface. The loss mechanisms considered are interactions with the solar wind and solar photons, thermal evaporation, and adsorption to the lunar surface. It is shown that during the LM stay-time, the contamination of the atmosphere is both appreciable and nonuniform in distribution, with the subsequent trend toward a uniform distribution proceeding at different rates for different exhaust gas species. Author

N67-15702*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMPARISON OF THE NEWTONIAN AND GENERAL RELATIVISTIC ORBITS OF A POINT MASS IN AN INVERSE SQUARE LAW FORCE FIELD
C. B. Solloway and H. Lass *In its* Space Programs Sum. No. 37–41, Vol. IV 31 Oct. 1966 p 1–6 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

The orbits of a mass point moving either by Newtonian or by relativistic mechanics in an inverse square law force field were compared by finding time analytic expressions for the differences in radial and transverse components of position and velocity. It was assumed that coordinate time was the same in both systems and that both particles had the same initial velocity and position values at the periapsis of the Newtonian orbit. Obtained expressions for radial deviation position, transverse deviation position, radial deviation velocity, and transverse deviation velocity were applied to the case of a fixed body equal to the mass of the Sun and a point mass corresponding to the asteroid Icarus, and the results were plotted in graphs. Radial and transverse components of range perturbations over long time intervals are quite distinctive, particularly the velocity components, and within the observable ability of our present day radar instruments. G.G.

N67-15707*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SOLAR PRESSURE EFFECT ON SPACECRAFT ATTITUDE AFTER GAS SYSTEM DEPLETION
E. H. Kopf, Jr. *In its* Space Programs Sum. No. 37-41, Vol. IV 31 Oct. 1966 p 27–32 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

It was desired to determine whether a Mariner-type spacecraft would continue to hold Sun line orientation after depletion of the Attitude Control gas or a quiescent gas system failure. With no control torques available, the spacecraft slowly begins to spin about the roll axis due to the "propeller" action of solar pressure. Telemetry has shown that this torque, dependent upon solar panel alignment, is typically about 5 dyne-cm. During the spin-up, it

would be possible to transmit via the omniantenna, and information could be recovered if Sun line control were maintained. Since the equations describing this motion could not be solved analytically and no suitable approximations could be made, it was decided to simulate this system on the IBM 7094 via numerical integration. This article describes the modeling procedure and some results obtained from the digital program. Author

N67-15766 Royal Greenwich Observatory, Herstmonceux (England).
PHOTOELECTRIC MAGNITUDES AND COLOURS OF SOUTHERN STARS, II
A. W. J. Cousins, R. Lake, and R. H. Stoy London, HMSO, 1966 65 p refs Prepared in Cooperation with the Royal Obs., Cape Town *Its* Bulletin No. 121
HMSO: 73s 6d

Photoelectric observations of stellar magnitudes and colours made at the Cape Observatory in the period 1961–1963 are combined into a single catalogue containing entries for over 2000 stars. The results are on the V, B–V, U–B and $(U-B)_C$ system. At least four observations contribute to each entry and, except for some of the faintest stars, the internal probable error of the catalogue entries does not exceed $\pm 0^m01$. Author

N67-15779# TRW Systems, Redondo Beach, Calif.
LINEARIZATION FOR CERTAIN EARTH–MOON TRAJECTORIES IN THE RESTRICTED PROBLEM OF THREE BODIES
K. Forster Feb. 1966 26 p refs
(TRW-9863-6005-RO-000)

A certain surface enclosing the moon is defined for the restricted three-body problem and it is proposed to linearize the equations of motion about points on this surface. As a preliminary study a development about two particular points on the surface is obtained and the equations of motion are integrated to the second order. The solutions are valid in a domain in which the moon's force increases from a fraction of the force exerted by the earth, to a value several times that force. Hence, the region of validity is the region of transition from the earth's field of influence to the moon's field of influence. Author

N67-15790*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FLOW FIELD COMPUTATIONS FOR BLUNT BODIES IN PLANETARY ATMOSPHERES
H. J. Stumpf *In its* Space Programs Sum. No. 37–40, Vol. 4 31 Aug. 1966 p 31–32 (See N67-15781 06-34) CFSTI: HC $3.00/MF $0.65

Computer programs for entry vehicle design studies are reviewed, and the problems involved in scaling to a full size vehicle are identified. An outline is also presented on a proposed computer study to determine, by numerical techniques, the state and motion variables and heat transfer distributions (both convective and radiative) about spherically blunted and spherically edged very blunt conical bodies, traveling at hypersonic velocities. The free stream conditions and blunt body velocities will be similar to those encountered in typical hyperbolic Mars entry trajectories where maximum stagnation point convective or radiative heat transfer occur. In this flow field computer study, calculations will be made for equilibrium ballistic range conditions, equilibrium flight conditions, and nonequilibrium flight conditions. A numerical technique check of flight conditions will also be made. M.G.J.

N67-15846*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
OGO PROGRAM–BIBLIOGRAPHY
George H. Ludwig, ed 30 Sep. 1966 84 p refs *Its* Issue 66-1 (NASA-CR-81210) CFSTI: HC $3.00/MF $0.65 CSCL 22A

An extensive bibliography, including abstracts and experiment descriptions, is presented for the Orbiting Geophysical Observatories (OGOs) I, II, III, E, and F. The bibliography includes published and unpublished scientific and technical papers, articles, and documents on OGO spacecraft and experiments. L.E.W.

N67-15904*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ENTRY CAPSULE ORBIT DETERMINATION ACCURACY
C. Scranage *In its* Space Programs Sum. No. 37-42, Vol. III 30 Nov. 1966 p 8–12 (See N67-15901 06-07) CFSTI: HC $3.00/MF $0.65

The feasibility of an on-board tracking system of two-way coherent doppler between an entry capsule and an orbiting bus for determining the orbit of an entry capsule and estimating atmospheric parameters was studied. Presented is a discussion of entry and impact statistics of the orbital parameters, a description of computer programs and procedures, and a presentation of the estimated uncertainties on the atmospheric constants. Results indicate that: (1) The proposed system is a highly reliable observable for determining the orbit of an entry capsule and estimating atmospheric parameters; and (2) The uncertainties on the estimates of the parameters do not appear to be as dependent on the inherent accuracy of the system as with an Earth-based system. Most significant of the results is that this new observable determined the stratosphere scale height, surface temperature, and stratosphere base temperature to a greater accuracy than was attained by the Mariner IV Mars occultation experiment. S.C.W.

N67-15907*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PIONEER PROJECT SUPPORT
D. W. Curkendall, J. E. Ball, and J. F. Gallagher *In its* Space Programs Sum. No. 37–42, Vol. III 30 Nov. 1966 p 21–23 refs (See N67-15901 06-07) CFSTI: HC $3.00/MF $0.65

The successful launch of Pioneer VII is reported and results of preorientation and postorientation orbit computations are summarized. The primary objective of the Pioneer VII mission was to send the spacecraft through the Earth's magnetosphere at a distance of several hundred Earth radii from the geocenter. On September 22, 1966, at about 12^hGMT, the Pioneer VII passed through syzygy with the Sun and Earth. The determined syzygy position satisfied the scientific needs of the magnetosphere experiment. The best orbit determination (October 26, 1966, postorientation 3) showed that there will be an occultation of the Pioneer VII by the Moon on January 20, 1967, at about 5^h30^mGMT. This occultation will be visible to the antenna where the lunar occultation experiment will be performed. A gas leak was discovered on the Pioneer VII. A cursory analysis of the perturbing effect of the gas leak on the trajectory of the spacecraft indicated that although its existence will considerably degrade the prediction of the probe position on January 20, an occultation should still occur. S.C.W.

N67-15993# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
LUNAR RESEARCH ON THE MOON
Zdenek Kopal and Wayne A. Roberts Aug. 1966 34 p refs *Its* Mathematical Note No. 479
(D1-82-0562; AD-641127) CFSTI: HC $3.00/MF $0.65

An outline of our present knowledge of the composition and internal structure of the Moon and of its surface environment is given in so far as it may affect our ability to establish a lunar base, and to define objectives for investigations to be carried out there. An outline of the methods to be used in such work is also

presented. It is stressed that the main objectives of the first lunar laboratory should be an investigation of the vertical structure of the surface to a depth of 100 - 1000 meters by direct methods (drilling), and down to its center by indirect methods, in order to provide a three-dimensional extension to two-dimensional prospecting of the surface from orbiting spacecraft. TAB

N67-16007*# National Academy of Sciences–National Research Council, Washington, D. C.
RADIO ASTRONOMY
In its Progr. in Sci. Radio 1966 p 221–305 (See N67-16001 06-34) CFSTI: HC $3.00/MF $0.65

Radio astronomical experiments and techniques are reported for: (1) *Filled-Aperture Radio Telescopes*—design and control, noncircular apertures, large parabolic radio antennas, spherical reflections, and tensor Fourier synthesis; (2) *Unfilled-Aperture Radio Telescopes*—aperture synthesis, earth-rotation synthesis using fixed antennas, optimum spacings, correlation array, and circular arrays; (3) *Radio Techniques*— image stability in radio telescopes, stability in electronic equipment, digital data processing, etc.; (4) *More Synthesis and Techniques*—frequency allocations for radio astronomy, protection of OH lines, calibration of signal intensities and solar radio flux density, solar absolute measurements, etc.; (5) *Solar Radio Spectroscopy: Interplanetary Plasma*—radio spectrographs for sun observation, electro-optic instantaneous spectrograph, interplanetary observations, and wake electron density measurements by Pioneer satellite; (6) *New Radio Telescopes and Galactic Radio Astronomy*—reflectors, grafting interferometers, multichannel telescopes, interstellar clouds, motion of interstellar gas, and galaxy as radio source; (7) *Extragalactic Radio Astronomy*—normal galaxies, strong discrete sources, and cosmic background emission. G.G.

N67-16021*# National Aeronautics and Space Administration, Washington, D. C.
MANNED SPACE-FLIGHT EXPERIMENTS, GEMINI IX MISSION Interim Report
1 Nov. 1966 143 p refs
(NASA-TM-X-59315) CFSTI: HC $3.00/MF $0.65 CSCL 22A

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7. EXPERIMENT D-14, UHF–VFH POLARIZATION R. E. Ellis (Naval Res. Lab.) p 97–127 (See N67-16028 06-29)

N67-16022*# Minnesota Univ., Minneapolis.
EXPERIMENT S-1, ZODIACAL LIGHT PHOTOGRAPHY
E. P. Ney and W. F. Huch *In* NASA, Washington Manned Space-Flight Expt., Gemini IX Mission 1 Nov. 1966 p 1–5 (See N67-16021 06-30) CFSTI: HC $3.00/MF $0.65

The objectives, equipment, procedure, and results of the Gemini IX zodiacal light photography experiment are described. The experiment was conducted to obtain 30-sec exposures of the airglow, the zodiacal light, and the Milky Way. The negatives are being studied using an isodensitracer to produce intensity isophotes. Data will be obtained on the intensity distribution of both morning and evening zodiacal light, the height and intensity of the airglow at various geographic positions, and the intensity distribution of the Milky Way in the region of the sky near Cygnus. A phenomenon appearing as an upward extension of the normal 90-kilometer airglow layer was discovered. The extension is in the form of wisps or plumes about 5° wide and extending upward about 5°. R.N.A.

N67-16023*# Dudley Observatory, Albany, N. Y.
EXPERIMENT S-10, AGENA MICROMETEORITE COLLECTION
Curtis L. Hemenway *In* NASA, Washington Manned Space-Flight Expt., Gemini IX Mission 1 Nov. 1966 p 7–11 (See N67-16021 06-30) CFSTI: HC $3.00/MF $0.65

The Agena micrometeorite collection experiment is described which was designed to provide, with a 2 to 4 month space exposure, data on micrometeorite cratering effects on selected highly polished surfaces, the collection of small micrometeorites at orbital altitudes by various thin films and soft plastics, and the lethal effects of the space environment on selected microorganisms. The first Agt vehicle, on which the loaded experiment hardware was mounted, failed to achieve orbit and the experiment hardware was lost. Another unit was mounted on the augmented target docking adapter (ATDA) for the Gemini IX-A mission. After completion of the rendezvous maneuver, it was determined that extravehicular activity to the ATDA would not be possible because of the failure of the ATDA shroud to jettison. However, an in-flight photograph of the experiment unit in place on the ATDA showed the outer surfaces of the unit to be in good condition. This photograph is included. R.N.A.

N67-16025*# Dudley Observatory, Albany, N. Y.
EXPERIMENT S-12, MICROMETEORITE COLLECTION
Curtis L. Hemenway *In* NASA, Washington Manned Space-Flight Expt., Gemini IX Mission 1 Nov. 1966 p 27–41 (See N67-16021 06-30) CFSTI: HC $3.00/MF $0.65

A micrometeorite collection experiment is described which was designed to obtain data during the Gemini IX mission on the flux of particle material in space as determined by direct collection and cratering effects of high velocity impacts, thin film penetration characteristics of micrometeorites, lethal effects of the space environment on microorganisms, and the probability of viable organisms in space either alone or in conjunction with micrometeoritic material. Only two of the eight samples have been examined in detail. The samples were scanned to detect and record any particulate matter on the surface of the film and to observe any damage caused by high velocity particles. Irregularly shaped particulate material was collected and penetration holes of varying size and concentration were found in the thin films. The sterile surfaces intended to collect organisms were cultured but they have shown no evidence of viable organisms to date. R.N.A.

N67-16056*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PUBLICATIONS OF THE JET PROPULSION LABORATORY JULY 1965 THROUGH JULY 1966
Royal L. Woods, comp. 15 Dec. 1966 87 p refs
(Contract NAS7-100)
(NASA-CR-81252; JPL-BIBL-39-7) CFSTI: HC $3.00/MF $0.65 CSCL 22A

An annotated bibliography prepared by the Jet Propulsion Laboratory covers technical reports and memorandums, the Space Programs Summary, astronautics information literature search, and JPL reporting in the open, domestic, and foreign literature. To facilitate use of this bibliography, numerical and subject indexes are included. R.U.

N67-16094*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
A COSMOLOGICAL MODEL FOR OUR UNIVERSE, I
Hong-Yee Chiu (State Univ. of New York, Stony Brook) [1966] 87 p refs
(NASA-TM-X-59317) CSCL 03B

A cosmological model was constructed for our Universe, based on current astronomical observations and two basic assumptions: Einstein's theory of general relativity is strictly valid without the cosmological constant and the existing laws of physics are strictly valid. Present knowledge of astronomical observations of our Universe and the cosmological models acceptable under the above assumptions are reviewed. Using statistical physics for equilibrium and non-equilibrium processes the course of evolution of our Universe was reconstructed, and an upper limit for the allowable matter–density of the Universe was obtained. It was found that the bulk part of matter–density in our Universe is in galaxies. The evolution of antimatter was calculated, and it was found that antimatter must be totally absent from our Universe. Based on the results obtained, a value of 0.02 for the deceleration parameter q_0 was determined. It was concluded that our Universe can be described by an open cosmological model of the Friedman type.
Author

N67-16101*# Arizona Univ., Tucson.
COMMUNICATIONS OF THE LUNAR AND PLANETARY LABORATORY, VOLUME 4, PART 4
Gerard P. Kuiper 1966 70 p refs *Its* Commun. no. 64–69
(Grant NsG-161-61)
(NASA-CR-80925) CSCL 03B

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4. OBSERVATIONS OF COMET IKEYA–SEKI (1965f) FROM MAUNA KEA, HAWAII A. K. Herring p 141–144 (See N67-16105 06-30)

5. OBSERVATIONS OF COMET IKEYA–SEKI (1965f) FROM TUCSON, ARIZONA S. M. Larson p 145–156 refs (See N67-16106 06-30)

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N67-16102*# Arizona Univ., Tucson.
THE COMPOSITION OF THE SURFACE LAYER OF MARS
Alan B. Binder and Dale P. Cruikshank 1 Oct. 1965 *In its* Commun. of the Lunar and Planetary Lab., Vol. 4, Pt. 4 1966 p 111–120 refs *Its* Contrib. No. 137 (See N67-16101 06-30)
(Grant NsG-161-61)

A comparison of the infrared spectra of the bright areas of Mars with that of terrestrial rock samples has resulted in some conclusions regarding the mineralogy and detrital cover of Mars. The bright deserts appear to consist of rock outcrops (e.g., in the basic crater structures as found by Mariner IV), and probably rock fragments of all sizes, coated for the most part with a hard surface stain of limonite. Limonite dust gives the polarization results published previously. Observations of the Martian dark areas and of terrestrial volcanic samples eliminate the hypotheses that the dark areas consist of either windswept basaltic lava fields or annual deposits of wind-blown volcanic ash. Color photographs of two areas in the southern Arizona (Sonoran) desert are appended with a brief discussion of the occurrence of limonite stains there.
Author

N67-16103*# Arizona Univ., Tucson.
MARTIAN CRATERING
William K. Hartmann 15 Jan. 1966 *In its* Commun. of the Lunar and Planetary Lab., Vol. 4, Pt. 4 1966 p 121–131 refs (See N67-16101 06-30)
(Grant NsG-161-61)

Independent counts of Martian and lunar craters are used in a new analysis of the Mariner IV records. The difference in impact velocities on the two planets introduces an appreciable effect. The Martian surface layer that has retained craters larger than 50 km in diameter is found to be 4×10^9 years old, within a factor of about 2. The diameter distribution of Martian craters agrees with that expected from impacts of asteroidal fragments, to the accuracy of the observations. At diameters less than 50 km, crater retention ages are less than 4×10^9 years, apparently because of an erosive process. The retention time for a crater 1 km in diameter is found to be on the order of 10^9 years; an erosive process flattens large-scale relief at an average rate of about 10^{-9} cm/yr. Fundamental conclusions about Mars' erosion history therefore cannot be drawn from the ages of the large craters only.
Author

N67-16104*# Arizona Univ., Tucson.
PRELIMINARY DRAWINGS OF LUNAR LIMB AREAS, VI
Alika K. Herring 4 Aug. 1965 *In its* Commun. of the Lunar and Planetary Lab., Vol. 4, Pt. 4 1966 p 133–140 refs (See N67-16101 06-30)
(Grant NsG-161-61)

Interpretive drawings, and the rectified photographs on which they were based, are presented for Area 22 and Areas 28 and 29. These extend the west lunar limb from 30° south latitude to the south pole.
N.E.N.

N67-16105*# Arizona Univ., Tucson.
OBSERVATIONS OF COMET IKEYA–SEKI (1965f) FROM MAUNA KEA, HAWAII
Alika K. Herring 20 Dec. 1965 *In its* Commun. of the Lunar and Planetary Lab., Vol. 4, Pt. 4 1966 p 141–144 (See N67-16101 06-30)

Visual and photographic observations from the Mauna Kea test site are described. Photographs, taken between October 27 and November 3, are presented, and include one exposed in strong morning twilight.
N.E.N.

N67-16106*# Arizona Univ., Tucson.
OBSERVATIONS OF COMET IKEYA–SEKI (1965f) FROM TUCSON, ARIZONA)
Stephen M. Larson 1 May 1966 *In its* Commun. of the Lunar and Planetary Lab., Vol. 4, Pt. 4 1966 p 145–156 refs (See N67-16101 06-30)

Photographs of the comet and tabulated data on pre-perihelion and post-perihelion observations are presented. Both photographic and visual observations, taken between September 22 and December 4, are described, including positions, size, color, and apparent visual magnitudes.
N.E.N.

N67-16107*# Arizona Univ., Tucson.
WAVELENGTH DEPENDENCE OF POLARIZATION, IV: VOLCANIC CINDERS AND PARTICLES
David L. Coffeen 29 Dec. 1964 *In its* Commun. of the Lunar and Planetary Lab., Vol. 4, Pt. 4, 1966 p 157–167 refs Repr. from Astron. J., v. 70, no. 6, Aug. 1965 p 403–413 Sponsored by ONR (See N67-16101 06-30)

Five laboratory samples were measured for comparison with the moon, using a Wollaston photopolarimeter with filters

near 0.36, 0.53, and 0.97 μ, having the sun as light source. Three of the samples were porous dust layers of ground volcanic cinder particles smaller than 37 μ in fairy-castle structures. The other two were: a porous but solid lava fragment, and the same fragment covered with a fairy-castle dust layer made from the same lava. The solid lava fragment is more highly polarized than the moon, and has essentially no wavelength dependence. The wavelength and phase dependence of the lunar polarization is closely matched by the fairy-castle structures. No dependence of polarization on sample orientation was found for the volcanic materials. Differential photometry was done with the same filters using a smoked MgO layer as comparison. All samples show a linear brightness increase (in magnitudes) from 50° to 20° phase, similar to the moon. The fairy-scale structures show an appreciable opposition effect in the ultraviolet which, however, almost disappears in the green and infrared. Author

N67-16122# Cornell Univ., Ithaca, N. Y. Center for Radiophysics and Space Research.

SMOOTHING RADIO ASTRONOMICAL DATA

Marshall H. Cohen Sep. 1966 9 p refs

(Contract Nonr-401(27))

(CRSR-251; AD-640392) CFSTI: HC $3.00/MF $0.65

Consideration is given to a radiometer output voltage which is put through an analogue filter and then sampled at uniform intervals. The resulting time series is filtered in various ways and then processed to get the desired information. Concern was mainly directed to the production of a power spectrum, with particular application to interplanetary scintillation data obtained at the Arecibo Ionospheric Observatory. The ideas are more general, however, and applications exist in many other areas. Author (TAB)

N67-16149# Arizona Univ., Tucson. Lunar and Planetary Lab.

INVESTIGATION OF O AND B SPECTRA OF STARS Final Report, Period Ending 30 Apr. 1966

B. M. Middlehurst 30 Apr. 1966 4 p refs

(Grant Nonr(G)-00029-64)

(AD-642144) CFSTI: HC $3.00/MF $0.65

A brief summary is given of an investigation of red shifts in the spectra of O and B type stars, which emphasized the so-called Trumpler stars. TAB

N67-16153# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio.

BUOYANT PLANETARY ENTRY

Reginangelo A. diPilla (M.S. Thesis) Mar. 1966 124 p refs

(GAM/AE/66A-2; AD-642361) CFSTI: HC $3.00/MF $0.65

It was assumed that the large buoyant volume is deployed prior to atmospheric entry. The effect of buoyancy on the entry dynamics was investigated, using a first-order entry model. That is, a two-dimensional entry trajectory, a perfectly spherical planet, a constant gravity, and no wind were assumed. It was found that the effect of buoyancy on the velocity, maximum deceleration, and altitude of maximum deceleration of planetary entry vehicles is insignificant. This is true for all entry angles, even if the entry velocity is decreased considerably by rocket braking, and even if the buoyant volume diameter is very large (greater than 500 feet). For buoyant planetary entry, the heating problem can be solved by several methods. The first of these methods would entail using expandable heat-resistant materials which could be expanded to protect the buoyant envelope prior to entry. In the second method, a cone or tension shell structure would be constructed around the buoyant volume while in Earth orbit. Author (TAB)

N67-16161# Academy of Sciences of the Armenian SSR, Erevan (USSR).

SOOBSHCHENIYA BYURAKANSKOY OBSERVATORII, ISSUE XXXVII

1966 82 p refs In RUSSIAN; ENGLISH summaries

CONTENTS:

1. SPECTROPHOTOMETRIC INVESTIGATION OF N HER 1963 N. L. Ivanova, M. A. Kazarian, and R. Kh. Hovhannisian p 3–17 refs (See N67-16162 06-30)

2. POLARIMETRIC OBSERVATIONS OF μ CEP K. A. Grigorian p 18–22 refs (See N67-16163 06-30)

3. POLARIZATION OF THE COLD SUPERGIANT STARS R. A. Vardanian p 23–47 refs (See N67-16164 06-30)

4. OBSERVATIONS OF EVERHART'S COMET (1964 h) IN BYURAKAN E. E. Khachikian and R. A. Epremian p 48–58 refs (See N67-16165 06-30)

5. APPLICATION OF PRINCIPLE OF DIGITAL TRANSFORMATION TO THE MEASUREMENT OF THE BRIGHTNESS DISTRIBUTION M. A. Martirosian p 59–71 refs (See N67-16166 06-30)

N67-16162# Academy of Sciences of the Armenian SSR, Erevan (USSR).

SPECTROPHOTOMETRIC INVESTIGATION OF N HER 1963

N. L. Ivanova, M. A. Kazarian, and R. Kh. Hovhannisian *In its* Soobshch. Byurakansk. Observ., Issue 37 1966 p 3–17 refs In RUSSIAN; ENGLISH summary (See N67-16161 06-30)

The results of the investigation on the physical conditions in the atmosphere of Nova Herculis 1963 are given. The star had unusually high spectrophotometric temperatures during the last days of March. An attempt was made to explain the changes of the color temperature by means of the expansion of the envelope. The temperature derived is 74,000°K. The obtained optical thickness of 0.05 permits the determination of the star's radius, which was found to be equal five solar radii. The following data on the envelope were determined: electron concentration, 10^7–10^8 cm^{-3}; mass, 10^{-3}–10^{-4} solar mass; and expansion velocity, 1450 km/sec. Author

N67-16163# Academy of Sciences of the Armenian SSR, Erevan (USSR).

POLARIMETRIC OBSERVATIONS OF μ CEP

K. A. Grigorian *In its* Soobshch. Byurakansk. Observ., Issue 37 1966 p 18–22 refs In RUSSIAN; ENGLISH summary (See N67-16161 06-30)

A continuation of previous polarimetric observations of μ Cepheus is reported. The results on μ Cepheus and standard stars are tabulated. It is noted that the observations show that the parameters of the polarizations of μ Cepheus are changing. Author

N67-16164# Academy of Sciences of the Armenian SSR, Erevan (USSR).

POLARIZATION OF THE COLD SUPERGIANT STARS

R. A. Vardanian *In its* Soobshch. Byurakansk. Observ., Issue 37 1966 p 23–47 refs In RUSSIAN; ENGLISH summary (See N67-16161 06-30)

The variability of the polarization of the cold supergiants in stellar associations has been shown. The variability of the degree of polarization is correlated with the brightness variations of the stars. The polarization is comparatively higher in the photographic part of the spectrum. It is concluded that the cold supergiant stars in associations show partly the intrinsic polarization. Author

N67-16165# Academy of Sciences of the Armenian SSR, Erevan (SSR).
OBSERVATIONS OF EVERHART'S COMET (1964 h) IN BYURAKAN
E. E. Khachikian and R. A. Epremian *In its* Soobshch. Byurakansk. Observ., Issue 37 1966 p 48–58 refs In RUSSIAN; ENGLISH summary (See N67-16161 06-30)

The results of absolute photometrical observations of Everhart's comet (1964 h) are presented. The information is based on observations with a 21-inch. and 40-inch. telescope system during September and October of 1964. Included are tables giving exposure data and photographic brightness of the comet on the various days, and illustrations showing gradient outlines.
Transl. by K.W.

N67-16166# Academy of Sciences of the Armenian SSR, Erevan (USSR).
APPLICATION OF PRINCIPLE OF DIGITAL TRANSFORMATION TO THE MEASUREMENT OF THE BRIGHTNESS DISTRIBUTION
M. A. Martirosian *In its* Soobshch. Byurakansk. Observ., Issue 37 1966 p 59–71 refs In RUSSIAN; ENGLISH summary (See N67-16161 06-30)

The instrument described transforms the blackness into intensities or stellar magnitudes. The method enables the almost automatic photometric measurements of the brightness distribution on different areas of the image. The calculated accuracy of the transformation method, and the results of tests on the model are presented.
N.E.N.

N67-16344# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MAN WENT INTO OUTER SPACE
13 Apr. 1966 6 p Transl. into ENGLISH from Grazhdanskaya Aviatsiya (Moscow), no. 11, 1965, p 15
(FTD-TT-66-27; TT-66-62512; AD-640958) CFSTI: HC $3.00/MF $0.65

Translation of Russian Research: Man went into Outer Space.
Author (TAB)

N67-16512*# Exotech, Inc., Washington, D. C.
ESTIMATION OF PLANETARY CONTAMINATION PROBABILITIES DUE TO FLIGHT OF THE U.S.S.R. VENUS 3
Samuel Schalkowsky 10 Aug. 1966 14 p refs
(Contract NASw-1340)
(NASA-CR-81256) CFSTI: HC $3.00/MF $0.65 CSCL 22A

An analysis of the question of planetary quarantine constraints for planned and future missions to Venus is presented. Due to the uncertainties associated with sources of information on the flight of Venus 3, the study is hampered in its estimation of planetary contamination probabilities. To reach meaningful conclusions concerning planetary quarantine constraints, the approach taken permits a relative rather than an absolute estimate. Considered are two limiting cases to represent the bounds on the probabilities of planetary contamination due to Venus 3 and the corresponding consequences for future Venus missions. It is concluded that the flight of the Venus 3 is not in itself likely to have produced contamination of the planet so as to render all future quarantine precautions unnecessary.
S.P.

N67-16515*# GCA Technology Div., GCA Corp., Bedford, Mass.
EXPERIMENTAL AND THEORETICAL STUDIES IN PLANETARY AERONOMY Quarterly Progress Report, 17 Sep.–30 Nov. 1966
F. F. Marmo Dec. 1966 131 p refs
(Contract NASw-1283)
(NASA-CR-81262; QPR-7) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Technical summaries are presented for studies in photochemistry of planetary gases, planetary aeronomy, and experimental investigations in the VUV (2000–1000 A) and the EUV (below 1000 Å) spectral regions. Results are discussed for the photochemistry of planetary gases in the EUV and for investigations of ion–molecule reactions in planetary atmospheres. Theoretical studies included work on the cooling rates of hot electrons in the Earth's atmosphere. Absorption and photoionization cross sections were measured for the atomic atmospheric species in the VUV and EUV. The kinetic energy and spatial distribution of ejected photoelectrons due to VUV and EUV photoionization was measured. Experimental devices such as windows, filters, and counters, were designed for use in the VUV and EUV investigations. Significant progress was achieved on observation of noctilucent clouds in planetary atmospheres.
S.P.

N67-16549*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON THE LONG PERIOD PERTURBATIONS IN THE MOTION OF SMALL ECCENTRICITY SATELLITES
Theodore L. Felsentreger and Eric L. Victor Dec. 1966 41 p Dec. 1966 41 p refs
(NASA-TM-X-55647; X-547-66-577) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Formulas are presented expressing the major long period perturbations by the earth in the eccentricity and argument of perigee of small eccentricity satellites; the formulas include terms which involve $(J_i/J_2)^3$, where J is any odd zonal harmonic coefficient in the earth's gravitational potential. The perturbation expressions are then used to analyze the satellites Alouette 1 and Tiros 8.
Author

N67-16551*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
REMARKS ON THE INTERPRETATION OF LUNIK 10 MAGNETOMETER RESULTS
Norman F. Ness Jan. 1966 16 p refs Submitted for Publication
(NASA-TM-X-55650; X-612-67-9) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Simultaneous measurements of the earth's magnetic tail performed by IMP 3 and Lunik 10 are compared because of the contrasting results obtained by the subsequent Explorer 33. subsequent results from Explorer 33 measured the magnetic tail at and beyond the lunar orbital distance in July–October 1966. The position of the moon was investigated in solar magnetospheric coordinates in order to interpret the Lunik data, and it was found that the magnitude and temporal variation is consistent with the satellite being imbedded in the earth's magnetic tail during full moon periods.
L.E.W.

N67-16561*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37–42, VOLUME VI FOR THE PERIOD SEPTEMBER 1 TO OCTOBER 31, 1966. SPACE EXPLORATION PROGRAMS AND SPACE SCIENCES
30 Nov. 1966 30 p
(Contract NAS7-100)
(NASA-CR-81293; JPL-SPS-37-42, Vol. VI) CFSTI: HC $3.00/MF $0.65 CSCL 22A

The star mapping maneuver and midcourse maneuver mission operations of the Surveyor II (SC-2) flight spacecraft; systems engineering and testing of the SC-3 (third flight) through SC-7

(seventh flight) spacecrafts; flight control tests on the roll actuator; redesign of the Surveyor I auxiliary battery and utilization on Surveyor II; reduction of Surveyor I flight telemetry data; and payload and scientific mechanisms for installation in the Surveyor spacecrafts, are discussed. Systems and assemblies design and development for the Mariner Venus 67 Project, the Mariner Mars 1969 O Project, and the Voyager Project, are and the capabilities, facilities, equipment installation and operations of the Deep Space Network are described. L.S.

N67-16575* Aeronutronic, Newport Beach, Calif.
STUDY OF THE AUTOMATED BIOLOGICAL LABORATORY PROJECT DEFINITION Volume I: Summary Final Report, 10 Aug. 1964–10 Aug. 1965
Temple W. Neumann 10 Sep. 1965 61 p
(Contract NASw-1065)
(NASA-CR-81309; U-3237, Vol. I) CFSTI: HC $3.00/MF $0.65 CSCL 22A

The feasibility of an automated biological laboratory (ABL) for use in the exploration of Mars was investigated. The objectives of the study included definition of the scientific objectives for such a mission, selection of a representative complement of experiments, definition of the required instrument complement, performance of a predefinition of the required instrument complement, performance of a preliminary design feasibility study for a representative design point payload, and the execution of a program definition and development plan. Desirable objectives and approaches to the biological exploration of Mars were defined. A great many possible experiments, both biological and physical, were evaluated and ranked numerically. A complement of 35 such experiments were selected for purposes of establishing a representative instrumentation payload for a Voyager-class landing mission to Mars in 1975. This payload was used as a basis for conducting a preliminary design feasibility evaluation of an automated biological laboratory. Author

N67-16576*# Aeronutronic, Newport Beach, Calif.
STUDY OF THE AUTOMATED BIOLOGICAL LABORATORY PROJECT DEFINITION. VOLUME II: SCIENTIFIC PAYLOAD DEFINITION STUDIES
Temple W. Neumann 10 Sep. 1965 146 p refs
(Contract NASw-1065)
(NASA-CR-81310; U-3237, Vol. II) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Scientific objectives, biological and environmental experiments, and scientific payloads for the automated biological laboratory (ABL) project are defined. Analytical methods, experimental constraints, and instrumentation used by the ABL for detecting extraterrestrial life on Mars are described. In the ABL concept the experimental program is conducted by an integrated complement of basic instruments operated in sequential fashion. The laboratory is controlled by an on-board computer, with command override capability provided for earth-based scientists to select alternative experimental programs, or to initiate completely new programs. The design point landed payload was designed for two year (earth) life on the surface of Mars, and resulted in a spherical configuration, 68 inches in diameter weighing about 1200 lbs. L.S.

N67-16587# TRW Systems, Redondo Beach, Calif.
MANNED EXPLORATION, COLONIZATION AND EXPLOITATION OF THE LUNAR SURFACE Selective Bibliography
L. R. Magnolia 10 Oct. 1966 9 p refs *Its* Lit. Survey 26
(TRW-99900-6045-T000; AD-641973) CFSTI: HC $3.00/MF $0.65

The report lists 124 references which are all available to the public. TAB

N67-16602* Stanford Univ., Calif. Radioscience Lab.
RESEARCH AT THE STANFORD CENTER FOR RADAR ASTRONOMY Semiannual Status Report, 1 Jul.–31 Dec. 1967
Jan. 1967 16 p refs
(Grant NsG-377)
(NASA-CR-81306; SASR-8) CFSTI: HC $3.00 CSCL 03A

Progress is reported in a number of theoretical and experimental investigations in radio and radar studies of space plasmas, lunar and planetary surfaces, communication theory, and spacecraft instrumentation. Of particular interest are a program of data analysis for an FM–CW lunar radar experiment and a program involved with the reception of Lunar Orbiter's S-band telemetry signals. Other areas discussed are planetary surface mapping, optical analysis of radar images, planetary atmosphere and ionosphere, signal processing, a solar radar program, signal channel coding schemes, and electron density determinations. C.T.C.

N67-16603*# Boeing Co., Seattle, Wash. Space Div.
A STUDY OF THE LUNAR ORBITER REGARDING ITS ADAPTABILITY TO SURFACE EXPERIMENTS UTILIZING A FLY-BY AND EARTH RETURN TRAJECTORY Final Report
6 Oct. 1966 118 p
(Contract NAS1-6216)
(NASA-CR-66269; D2-100690-4; L-6753) CFSTI: HC $3.00/MF $0.65 CSCL 22C

The lunar flyby and earth return trajectory was duplicated closely using Lunar Orbiter trajectory programs. Targeting the Atlas/Agena booster for this specific trajectory requires that: (1) the Agena use a long coast, between 1/2 and 1 orbit, and (2) launch time and azimuth be tied to a single value; this reduces the customary launch window of 2 to 4 hours. Major conclusions are that the trajectory could be flown by the Lunar Orbiter, but other free-return trajectories not constrained to a specific time would be easier. Accuracy obtained with Lunar Orbiter is adequate with two midcourse corrections each way; requirements being 211 m/second out of an available 912 m/second. Tracking and orbit prediction capability of MSN could be fully exercised with no change to Lunar Orbiter or MSN if spacecraft command and control is left with DSIF and SFOF at Pasadena. The mission plan must take into account thermal, power, communication, video transmission, and DSIF and MSN tracking requirements. An additional 64 pounds could be carried on the mission without off-loading propellant, and the spacecraft could be placed into an earth orbit upon return instead of reentering and being destroyed by using the unspent propellant. C.T.C.

N67-16604*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
PRESTO VERSION DELTA: PROGRAM FOR RAPID EARTH-TO-SPACE TRAJECTORY OPTIMIZATION
Richard C. Rosenbaum, Robert E. Wilhwerth, Jr., and Richard L. Moll Washington, NASA, Jan. 1967 14 p
(Contract NAS1-5255)
(NASA-CR-684) CFSTI: HC $3.00/MF $0.65 CSCL 22C

This report presents documentation for modifications to the current trajectory optimization program known as PRESTO which was developed. These modifications reduce the core storage requirements and improve the computational speed of the PRESTO program. The modified program is called the PRESTO VERSION DELTA. Author

N67-16611* Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
EXPERIMENTAL INVESTIGATION OF ULTRA-HIGH VACUUM ADHESION AS RELATED TO THE LUNAR SURFACE Quarterly Progress Report, 1 Oct.–31 Dec. 1966

J. A. Ryan 26 Jun. 1964 26 p ref
(Contract NAS7-307)
(NASA-CR-81348; QPR-10) CFSTI: HC $3.00 CSCL 22A

Studies have been concerned with measurements of adhesion between various silicate minerals whose surfaces have been formed by cleavage in ultrahigh vacuum, and with modifications in the present experimental apparatus to provide further information as to the nature of the adhesional forces acting. Of particular note is the highly varied behavior of the long range attractive force which has become more evident. This force field appears often to be anisotropic on a macroscopic scale, forcing the samples into their pre-cleavage orientation even when a significant mismatch is initially present. An electrometer probe is being fabricated for installation in the vacuum system. This probe will be used to obtain plots of the charge distribution over the surface. Author

N67-16615* California Univ., San Diego.
THE REDSHIFT AND ABSORPTION-LINE SPECTRUM OF PKS 0237-23
E. M. Burbidge 2 Dec. 1966 7 p refs Submitted for Publication
(Grant NsG-357)
(NASA-CR-81343) CFSTI: HC $3.00 CSCL 03B

A new radio source, PKS 0237-23, has been identified with a stellar object, and the spectra obtained together with photometry shows definitely that the source is a quasi-stellar object; the emission lines give a large red shift. The striking feature of the optical radiation from PKS 0237-23, apart from its large red shift, is that it has a considerable number of absorption lines in the blue and ultraviolet, much the same as 3C 191. A pair of strong absorption lines in PKS 0237-23 are seen at 4116 and 4141 Å. These are close to the Si IV lines in 3C 191, with rest wavelengths of 1393.8 and 1402.8 Å. The problem of identification is discussed purely from the point of view of normal spectroscopy, and it is shown that none of the possibilities are satisfactory. Despite the puzzling features of PKS 0237-23, it is concluded that the object has an absorption line red shift of 1.95. C.T.C.

N67-16617*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
THE SHORT-PERIOD DRAG PERTURBATIONS OF THE ORBITS OF ARTIFICIAL SATELLITES
L. Sehnal and Sara B. Mills 3 Oct. 1966 36 p refs
(Contract NsG-87-60)
(NASA-CR-81341; SAO Special Rept.-223) CFSTI: HC $3.00/MF $0.65 CSCL 22C

The aim of the paper is the computation of short-period perturbations of the elements of the orbits of artificial satellites, caused by atmospheric drag. The density function of the earth's atmosphere includes the effect of the atmospheric bulge, described by a formula given by Jacchia. The method of the solution is in essence the method of construction of the disturbing function on an electronic computer; the formulas needed for such computations and some numerical results are given. Author

N67-16621*# Centre National d'Etudes Spatiales, Bretigny-sur-Orge (France). Division Mathematiques et Traitement.
BULLETIN OF ORBITAL DATA. PART I: ORBIT PARAMETERS [BULLETIN DE RENSEIGNEMENTS ORBITAUX. PARTIE I: PARAMETRES D'ORBITE]
[1966] 9 p In FRENCH
(NASA-TT-F-10468) CFSTI: $3.00/MF $0.65 CSCL 22C

A mathematical model is presented to determine the latitude and longitude of a satellite's trajectory. Tabular data show average orbit parameters, long-period terms, friction, and quatratic terms used for the calculation. The method can be extended to estimating the azimuth, height and distance from Earth of the satellite in its orbit. Transl. by R.Ll.

N67-16624*# Boeing Co., Seattle, Wash.
A STUDY OF THE LUNAR ORBITER REGARDING ITS ADAPTABILITY TO EXPERIMENTS TO EVALUATE LUNAR SURFACE CHARACTERISTICS, PHASE I Final Report
29 Sep. 1966 255 p refs
(Contract NAS1-6216)
(NASA-CR-66268; D2-100690-2; L-6753) CFSTI: HC $3.00 CSCL 22A

The following aspects are considered in this study: (1) lunar surface hardness and composition; (2) translunar injection requirements; (3) three-sigma minimum Lunar Orbiter velocity capability; (4) launch date effects on spacecraft weight; (5) Lunar Orbiter weights; (6) Early Lunar Flare (ELF) and typical flare delivery system definition; (7) balloon and typical balloon delivery system definition; and (8) penetrometers and a candidate penetrometer system. Presented in addition are pertinent experiment descriptions, working papers on the flare experiment and possible communication modifications, and working papers on penetrometers. K.W.

N67-16671*# Mount Auburn Research Associates, Inc., Cambridge, Mass.
THEORY OF ELECTROSTATIC PLANAR AND SPHERICAL PROBES
Lee W. Parker Washington, NASA, Jan. 1967 98 p refs
(Contract NAS5-9088)
(NASA-CR-704) CFSTI: HC $3.00/MF $0.65 CSCL 04A

By considering which trajectories of an electrostatic plasma probe are populated and which are not, a theoretical expression is obtained for the current collected by a planar probe assumed to be embedded in the skin of a large satellite in the ionosphere plasma. This expression is in the form of an integral over velocity space. The analytical properties of the domain in velocity space .which corresponds to populated trajectories are investigated. The shape of the domain governs the current characteristics of the probe. General formulae are derived which depend on the shape of the domain. An approximate theory is employed to obtain an analytical form for the shape of the domain, and expressions are derived for the current characteristics of the probe. Comparison is made between the theoretically derived characteristics and those computed by numerical trajectory calculations. An approximate theory is also employed for the spherical probe, based on a powerlaw potential model. The planar and spherical probes are compared. Author

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N67-16669*# Goodyear Aerospace Corp., Akron, Ohio.
PASSIVE GEODETIC SATELLITE CANISTER ASSEMBLIES
James O. Gibson and Robert R. Carman Washington, NASA, Jan. 1967 63 p refs
(Contract NAS1-4971)
(NASA-CR-700) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The passive geodetic satellite (PAGEOS) canister assemblies were designed, analyzed for structural integrity and thermal stability, fabricated in quantities of five units, and tested for conformance to the design parameters. The testing program required that components and materials, not previously qualified for the PAGEOS environmental conditions specified, must be tested to sufficient levels to prove their integrity. The pre-prototype was used for static structural testing. The prototype was used for dynamic and thermal testing to the qualification levels of the launch and trajectory-to-orbit environmental conditions. Satisfactory completion of the qualification tests was required as a prerequisite to fabrication of the flight canister assemblies. A high reliability was desired for the flight canister assemblies. Therefore, a thorough program of reliability analysis, monitoring of design and procurement drawings and specifications, as well as failure reporting and canister analysis, was implemented. To ensure high reliability, a quality assurance program was implemented to maintain a tight surveillance during the fabrication and testing of in-house hardware and during receipt and testing of procured hardware. Technical requirements of the canister assembly were met by the spacecraft. Author

N67-15682*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RANGER VI MISSION DESCRIPTION AND PERFORMANCE
15 Dec. 1966 84 p refs
(Contract NAS 7-100)
(NASA-CR-81193; JPL-TR-32-699) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Mission and project background are summarized, followed by descriptions of: (1) launch preparation and operations; (2) Atlas and Agena operation and performance; (3) spacecraft and subsystems performance; (4) Deep Space Network operations; (5) space flight operations; (6) flight path and maneuvers; (7) television subsystem failure; (8) spacecraft improvements for Ranger VI; and (9) spacecraft configuration and interfaces. K.W.

N67-15685*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-41, VOLUME VI FOR THE PERIOD JULY 1 TO AUGUST 31, 1966. SPACE EXPLORATION PROGRAMS AND SPACE SCIENCES
30 Sep. 1966 43 p
(Contract NAS7-100)
(NASA-CR-81190; JPL-SPS-37-41, Vol. VI) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Summaries are presented of the following developments: (1) Surveyor I mission operations, performance, systems testing, electric power source, flight control, and mechanisms; (2) design, development, testing, and mission analysis for the projects Mariner Venus 67, Mariner Mars 1969, and Voyager; (3) Deep Space Network capabilities, facilities, and instrumentation facility development and operations; (4) Mars cartography from the Mariner IV TV pictures; and (5) supporting activities concerning environmental test equipment, including a thermal radiation lamp bank reflector and a contamination collection plate. K.W.

N67-15715*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TOUCHDOWN STABILITY STUDY
J. A. Garba *In its* Space Programs Sum. No. 37-41, Vol. IV 31 Oct. 1966 p 62-64 refs (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

A three-dimensional lunar touchdown stability study for a Surveyor vehicle landing system was initiated by the development and checkout of a computer program suitable for establishing stability boundaries as a function of 11 parameters. Considered were: 9 initial conditions of the spacecraft, the surface slope, and the coefficient of friction. The Surveyor vehicle landing system consisted of three inverted tripod legs and three blocks mounted under the frame symmetrically about the roll axis of the vehicle; hydraulic springs in parallel with a viscous damper and a coulomb friction mechanism provided shock absorbtion. Results indicated that the mount of stability degradation due to three-dimensional effects was not a function of the number of legs alone but depended also on the particular vehicle geometry; namely, the ratio of the center of gravity location above the base polygon to the critical overturning radius. G.G.

N67-15764*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
VENUS CAPSULE SCIENCE
R. G. Brereton, R. W. Davies, and C. E. Griffin *In its* Space Programs Sum. No. 37-41, Vol. IV 31 Oct. 1966 p 285-288 refs (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

Instruments for measuring the altitude dependent physical properties of the Cytherean atmosphere from an entry capsule are described. The purpose of these measurements is to establish an altitude profile of gas density, temperature, pressure, and composition. A suggested capsule scientific payload weighing about 16 lb. is discussed which consists of a thermodynamic variables package, atmospheric composition experiment, impact accelerometer, visual and/or UV photometer, and triaxial accelerometer. A.G.O.

N67-15884*# Southwest Research Inst., San Antonio, Tex.
THE DYNAMIC BEHAVIOR OF LIQUIDS IN MOVING CONTAINERS, WITH APPLICATIONS TO SPACE VEHICLE TECHNOLOGY
H. Norman Abramson, ed. Washington, NASA, 1966 479 p refs
(Contract NASr-94(07))
(NASA-SP-106) GPO: HC $2.75; CFSTI: MF $0.65 CSCL 22B

CONTENTS:

1. THE DYNAMIC BEHAVIOR OF LIQUIDS IN MOVING CONTAINERS H. N. Abramson p 1-11 refs (See N67-15885 06-12)

2. LATERAL SLOSHING IN MOVING CONTAINERS S. Silverman and H. N. Abramson p 13-78 refs (See N67-15886 06-12)

3. NONLINEAR EFFECTS IN LATERAL SLOSHING H. N. Abramson, W.-h. Chu, and F. T. Dodge p 79-103 refs (See N67-15887 06-12)

4. DAMPING OF LIQUID MOTIONS AND LATERAL SLOSHING S. Silverman and H. N. Abramson p 105-143 refs (See N67-15888 06-12)

5. SIMULATION AND EXPERIMENTAL TECHNIQUES. PART I: SIMULATION OF LIQUID SLOSHING J. F. Dalzell p 145-169 refs (See N67-15889 06-12)

6. EXPERIMENTAL TECHNIQUES AND APPARATUS G. W. Brooks p 170-197 refs (See N67-15890 06-12)

7. ANALYTICAL REPRESENTATION OF LATERAL SLOSHING BY EQUIVALENT MECHANICAL MODELS F. T. Dodge p 199-223 refs (See N67-15891 06-12)

8. VEHICLE STABILITY AND CONTROL H. F. Bauer (Ga. Inst. of Tech.) p 225-267 refs (See N67-15892 06-31)

9. VERTICAL EXCITATION OF PROPELLANT TANKS F. T. Dodge p 269-301 refs (See N67-15893 06-32)

10. INTERACTION BETWEEN LIQUID PROPELLANTS AND THE ELASTIC STRUCTURE D. D. Kana p 303-352 refs (See N67-15894 06-32)

11. LIQUID IMPACT ON TANK BULKHEADS J. F. Dalzell p 353-372 refs (See N67-15895 06-32)

12. LIQUID ROTATION AND VORTEXING DURING DRAINING F. T. Dodge p 373–377 refs (See N67-15896 06-12)

13. LONGITUDINAL OSCILLATIONS OF FLIGHT VEHICLES D. D. Kana p 378–385 refs (See N67-15897 06-31)

14. LIQUID PROPELLANT BEHAVIOR AT LOW AND ZERO g W. C. Reynolds (Stanford Univ.) and H. M. Satterlee (Lockheed Missles and Space Co.) p 387–439 refs (See N67-15898 06-27)

APPENDIXES

15. PHYSICAL PROPERTIES OF SELECTED LIQUIDS p 443–449 refs

N67-15892*# Georgia Inst. of Tech., Atlanta. Dept. of Engineering Mechanics.

VEHICLE STABILITY AND CONTROL

Helmut F. Bauer *In* Southwest Res. Inst. Dyn. Behavior of Liquids in Moving Containers 1966 p 225–267 refs (See N67-15884 06-12) GPO: $2.75; CFSTI: MF $0.65

Consideration is given to the general problem of dynamics and stability of a launch vehicle under thrust. Since the largest portion of the launch vehicle's total weight is in the form of liquid propellant, the problem of interaction of the sloshing propellant with the vehicle motion remains an important consideration throughout the powered flight. The general problem considered is the motion of the center of mass, the vehicle attitude, the motion of the propellants in the tanks, and the lateral bending of the vehicle structure under the action of a control system. An attempt is made to determine ways to decrease the influence of propellant sloshing on the stability of the vehicle by proper container geometry and location, to select the control system and its gain values, and to obtain the requirements for additional baffles to provide damping of the liquid in the containers. R.N.A.

N67-15897*# Southwest Research Inst., San Antonio, Tex.

LONGITUDINAL OSCILLATIONS OF FLIGHT VEHICLES

Daniel D. Kana *In its* Dyn. Behavior of Liquids in Moving Containers 1966 p 378–385 refs (See N67-15884 06-12) GPO: HC $2.75; CFSTI: MF $0.65

Longitudinal structural oscillations at low frequencies, superimposed on the usual steady accelerating motion, have been observed on several rockets and launch vehicles during flight. The basic structural oscillation occurs in the fundamental longitudinal free–free mode so that the vehicle experiences an accordian-like motion, with the ends of the vehicle moving out of phase with respect to each other. This behavior has been nicknamed "pogo" oscillation. This behavior can be explained by the fact that at some time during the ascent trajectory, an unstable coupling between some vehicle subsystem and the structure occurs, so that an oscillation at the structural frequency builds up, levels off, and decays after enough change has occurred for the coupling to become stable again. A qualitive description is given of both engine-structure and pressure regulator-structure couplings which have been observed, along with a brief description of several of the devices used as fixes. The discussion attempts to view the overall role of the liquid fuel systems in the occurrence of the pogo behavior rather than to describe this behavior in any specific vehicle. R.N.A.

N67-16051*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

MICROBIOLOGICAL BURDEN ON THE SURFACES OF THE AIMP SPACECRAFT, PART 2

Edmund M. Powers Jun. 1966 10 p ref

(NASA-TM-X-55629; X-624-66-368) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The sampling procedure and decontamination of the microbiological burden on the surfaces of the Anchored Interplanetary Monitoring Platform (AIMP) spacecraft are reported. Data obtained so far indicate that the average surface contamination of the spacecraft during the five phases of assembly is 9.6×10^3 viable particles per square foot of surface before decontamination, and 2.3×10^2 viable particles after decontamination. As evidenced by the reduction in numbers after decontamination, the procedure appeared effective. An average of the counts obtained during assembly indicates a reduction of about 2 logs per square foot of surface after decontamination. R.LI.

N67-16052*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

MICROBIOLOGICAL BURDEN ON THE SURFACES OF THE AIMP SPACECRAFT, PART 3

Edmund M. Powers Jul. 1966 31 p refs

(NASA-TM-X-55630; X-624-66-369) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The decontamination and monitoring of the occluded surfaces of the AIMP spacecraft (surfaces under the protective cover) was completed. This report, which describes the sixth phase of the assembly, is the third in a series on the decontamination and microbiological monitoring of the AIMP spacecraft. These reports follow the state of decontamination and microbiological contamination from the first to the final stages of assembly. A summary of the microbial contamination on the surfaces of the spacecraft during each phase of the assembly is reported. Author

N67-16053*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

MICROBIOLOGICAL BURDEN ON THE SURFACES OF THE AIMP SPACECRAFT, PART 4

Edmund M. Powers Aug. 1966 16 p refs

(NASA-TM-X-55631; X-624-66-370) CFSTI: HC $3.00/MF $0.65 CSCL 22B

For the sterilization program to reduce microorganisms of all planet-bound spacecraft, contamination detected on the surfaces of the Anchored Interplanetary Monitoring Platform (AIMP) is shown graphically. Data are also tabulated on the decontamination effect on the total microbial burden of the spacecraft, results of decontamination or cleaning of the solar paddles with methyl ethyl ketone (MEK), the microbiological contamination in the air of the clean rooms housing the AIMP spacecraft during the last assembly stages, the microbiological profile of the air in two clean rooms during two typical work days, and the microbiological fallout on stainless steel strips over a four-week period. The accuracy of earlier estimates of microorganisms on surfaces was confirmed, and the actual total microbial burden determined was 2.68×10^5 after decontamination. R.LI.

N67-16081*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

BASIC STUDIES IN SPACE VEHICLE ATTITUDE CONTROL

Eleventh Semiannual Status Report

Dec. 1966 15 p refs

(Grant NsG-133-61)

(NASA-CR-80924) CSCL 22B

CONTENTS:

1. NONLINEAR STUDIES, OPTIMAL CONTROL I. Fluegge-Lotz p 2–6 (See N67-16082 06-31)

2. SATELLITE ORBIT STUDIES J. V. Breakwell p 7–10 refs (See N67-16083 06-31)

N67-16082*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
NONLINEAR STUDIES, OPTIMAL CONTROL
I. Fluegge-Lotz *In its* Basic Studies in Space Vehicle Attitude Control Dec. 1966 p 2–6 (See N67-16081 08-31)

Summary reports are given of research activities in nonlinear and optimal control of planet-pointing space vehicles, including steady state consideration of optimal and suboptimal control of a satellite in elliptic orbit, complete attitude control problem for an earth satellite in elliptic orbit, validity of linearization in attitude control, and computation of optimal controls by a method based on second variations. L.E.W.

N67-16083*# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
SATELLITE ORBIT STUDIES
J. V. Breakwell *In its* Basic Studies in Space Vehicle Attitude Control Dec. 1966 p 7–10 refs (See N67-16081 08-31)

Research activities in the field of satellite orbits are summarily discussed, and results are reported for two particular projects: earth-satellite orbits in resonance with a tesseral perturbation and motion near earth–moon L_4 libration point. L.E.W.

N67-16100# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.
DESCRIPTION OF THE INJUN V VLF EXPERIMENT
Donald A. Gurnett, Stanley D. Shawhan, and G. William Pfeiffer Oct. 1966 61 p
(Rept.-66-43)

The mechanical configuration, electrical system, calibration procedure, and equipment developed for the Injun V very low frequency experiments are described in detail. The scientific objectives of the experiments are outlined, e.g., observing frequency–time spectra of VLF radio noise phenomena in the frequency range 30 Hz to 10 KHz and measuring the relative phase and amplitude of the electric and magnetic fields of radio noise phenomena. Consideration is also given to the system weight and power consumption. L.E.W.

N67-16506*# National Aeronautics and Space Administration, Manned Spacecraft Center, Langley Station, Va.
APOLLO SPACECRAFT CONTROL SYSTEMS
Robert G. Chilton [1965] 28 p refs Presented at the Symp. on Autom. Control in Peaceful Uses of Space, Stavanger, Norway, 21–24 Jun. 1965
(NASA-TM-X-59316) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The overall Apollo spacecraft configuration includes two separate manned spacecraft. They are the command module designed for earth launch and reentry and cislunar flight including lunar orbit, and the lunar excursion module designed for the excursion from lunar orbit to the moon's surface and return. Each spacecraft has its own independent guidance and control system. The Apollo spacecraft control systems including engine control and rocket engine configurations for attitude control are described. The guidance systems are not discussed. Author

N67-16514*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
ARIELI, THE FIRST INTERNATIONAL SATELLITE. EXPERIMENTAL RESULTS
1966 163 p refs
(NASA-SP-119) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The entire Ariel I project is summarized including descriptions of experimental results, spacecraft design and performance, tracking, data acquisition, and data reduction. Experiments aboard Ariel I were selected to take advantage of techniques developed as part of the Skylark sounding rocket program, and to provide an integrated assault on unknowns connected with the sun–ionosphere relation. Extensive discussions on such experiments as the energetic particle measurements and use of the Langmuir probe for measuring electron temperature and density are presented. The structural and mechanical design of the satellite itself is examined, and the development of a separation and release system interface structure and associated mechanisms is summarized. Tracking, data acquisition, and data processing are briefly mentioned. S.P.

N67-16577*# Aeronutronic, Newport Beach, Calif.
STUDY OF THE AUTOMATED BIOLIOGICAL LABORATORY PROJECT DEFINITION. VOLUME III: SYSTEM ENGINEERING STUDIES Final Report, 10 Aug. 1964–10 Aug. 1965
Temple W. Neumann 10 Sep. 1965 627 p refs
(Contract NASw-1065)
(NASA-CR-81307; U-3237, Vol. III) CFSTI: HC $3.00/MF $0.65 CSCL 22B

System engineering activities for the automated biological laboratory to be used in exploring extraterrestrial life on Mars, are discussed. Objectives and constraints for the system are outlined; and special payload studies, and laboratory automation, preliminary design, and interface studies are described. The selection of landing sites is discussed, and existing planetary programs are analyzed. Conclusions resulting from the study are given, and recommendations are made. L.S.

N67-16578*# Aeronutronic, Newport Beach, Calif.
STUDY OF THE AUTOMATED BIOLOGICAL LABORATORY PROJECT DEFINITION. VOLUME IV: PROGRAM PLAN Final Report, 10 Aug. 1964–10 Aug. 1965
Temple W. Neumann 10 Sep. 1965 67 p
(Contract NASw-1065)
(NASA-CR-81312; U-3237, Vol. IV) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Major interactions are indicated between the ABL program and related activities, including Voyager capsule interfaces, supporting technology and research programs, and facilities and special equipment requirements. Considerable emphasis is given to implications of sterilization requirements because of the strong impact on all phases of ABL. Schedule and phasing discussion is presented which contains a preliminary PERT schedule chart for reference. Schedule analysis has indicated requirements for early initiation of key activities including supporting technologies on which to base development and design, and construction of key facilities to accommodate assembly, testing, and operation. The schedule assumes that preliminary design and system definition continues without interruption from the current study activities. Total costs for the ABL program are estimated. Author

N67-16665*# Arizona State Univ., Tempe.
ATTITUDE STABILITY OF A SPINNING PASSIVE ORBITING SATELLITE
Leonard Meirovitch and Frank B. Wallace, Jr. Washington, NASA, Jan. 1967 222 p refs
(Grant NGR-03-001-014)
(NASA-CR-665) CFSTI: HC $3.00/MF $0.65 CSCL 22C

The problem of the stability of motion of a rigid spinning satellite having unequal moments of inertia about axes perpendicular to

the spin axis and whose mass center moves in a circular orbit was studied using three separate methods of analysis. The first method consisted of an adaptation of the Liapounov second or direct method of analysis into a form that was suitable for use with the periodic systems; the second method developed was suitable for describing the regions of parametric resonance of multi-degree-of-freedom, linear, periodic systems of the type encountered in rigid body dynamics problems; and the third method involved the application of asymptotic methods to the multi-degree-of-freedom periodic systems. The boundaries of the regions of instability are defined for the motion of the linearized system in the neighborhood of the equilibrium position in which the spin axis is normal to the orbit plane. Unstable regions identified as principal instability regions were in agreement with previous researchers. The stability of motion of a spinning, rigid symmetric satellite in an elliptic orbit was also studied. Consideration is given to the linearized as well as the nonlinear system, and the equilibrium position in which the spin axis is normal to the orbit plane was studied. In addition to the instability regions predicted by the linearized system, new instability regions associated with the nonlinear terms are obtained and the occurrence of nonlinear stiffening of the system tending to limit the amplitude of resonance oscillation is noted. S.C.W.

N67-16699* General Dynamics/Convair, San Diego, Calif.
FLIGHT-WIND RESTRICTIONS PROCEDURE, ATLAS/CENTAUR AC-10 THROUGH AC-15
J. A. Steele 29 Apr. 1966 51 p refs
(Contract NAS3-8701)
(NASA-CR-81378; GDC-BTD66-063) CFSTI: HC $3.00/MF $0.65 CSCL 22D

The majority of loads which can be applied to the Atlas/Centaur vehicle in flight can be calculated well in advance of the vehicle's launch date. One effect, however, that of the prevailing atmospheric wind conditions, hereafter called the wind profile, must be accounted for just prior to launch if success is to be assured during marginal weather. The starting point of the analysis is the structural capability of the vehicle. This capability, determined from the vehicle's as-built condition, is used in conjunction with the pre-calculated loads and with the loads obtained using the flight-wind profile in order to determine whether the vehicle can be safely launched. The method employed is basically the same as that used for the four preceding vehicles. This method employs the calculated axial load in addition to the calculated bending moments, both being dependent upon the wind profile. Considered also are the vehicle's limit allowable bending moments and axial loads. Previously, ultimate allowables divided by factors of safety had been employed in this analysis. A 30-fps gust is used in the AC-10 simulation program. A rapid analysis on the IBM 7094 computer, combined with rapid analysis of output film on a microfilm recorder unit, comprises the basis of a recommendation relayed to the launch complex within minutes after obtaining the flight-wind profile. Author

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N67-15367# Ballistic Research Labs., Aberdeen Proving Ground, Md.
VISCOUS CORRECTIONS TO STEWARTSON'S STABILITY CRITERION
E. H. Wedemeyer *In* AGARD The Fluid Dyn. Aspects of Ballistics 1966 p 99–116 refs (See N67-15361 06-12) CFSTI: HC $3.00/MF $0.65

Stewartson's theory on the stability of a spinning top containing liquid has been very successful in predicting instabilities of spin-stabilized, liquid-filled shell. However, some discrepancies between theoretical and experimental ranges of instability have been observed by Ward and confirmed by Karpov. According to Stewartson, the spinning top is unstable whenever its frequency of nutation (or precession) falls within a certain bandwidth about any of the natural frequencies of the liquid. Experimentally it was found that the bandwidth for instability was considerably larger and the central frequency shifted relative to theoretical values. Guided by Karpov's observation that liquid viscosity was responsible for the observed discrepancies, Stewartson's theory was reexamined, taking into account viscous terms in the dynamic equations for the liquid. These terms had been neglected by Stewartson. The modified theory explains both the broadening of the bandwidth and the frequency shift due to viscosity. Comparison with experiments shows excellent agreement. Author

N67-15412# California Univ., La Jolla. Dept. of the Aerospace and Mechanical Engineering Sciences.
DISSIPATION FUNCTION IN THERMOMECHANICAL PHENOMENA OF VISCOELEASTIC SOLIDS
Nai-Chien Huang Oct. 1966 23 p refs
(Contract N00014-67-A-0109-0003)
(TR-1; AD-640858) CFSTI: HC $3.00/MF $0.65

An explicit form of the dissipation function associated with thermomechanical phenomena of viscoelastic solids is derived. This function is expressed in terms of the observable quantities such as stress rates, strain rates, and their second time derivatives, etc. The formulation is based on the theory of irreversible thermodynamics of deformable bodies developed by Biot and generalized by Ziegler and Schapery. The proposed dissipation function can be used conveniently for both experimental and theoretical purposes. Author (TAB)

N67-15428*# Israel Program for Scientific Translations, Ltd., Jerusalem.
DYNAMICS AND STRENGTH OF SHELLS
P. M. Ogibalov 1966 321 p refs Transl. into ENGLISH of the book "Voprosy Dinamiki i Ustoichivosti Obolochek" Moscow, Izd. Moskovskogo Univ., 1963 Published for NASA and NSF
(NASA-TT-F-284; TT-65-50118) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Fundamental information on shells concerning vibrations, flutter, and stability is presented. General elements of shells, such as the state of stress and strain, variational interpretation of the shell theory, and equations of motion, are explained. Equations are presented for elastic vibrations of thin shells and for flutter in panels or shells immersed in a stream of fluid. Other dynamic problems such as radial elastic deformation, propagation of elastic waves in shells, and planar elastoplastic deformation are discussed. Studies of shell stability in the range of elasticity and beyond the elastic limit are mentioned. Finally special problems in calculating shells are suggested. They include the variational approach to elastoplastic deformation, determination of carrying capacity, shells with inhomogeneous mechanical properties, shells heated by radiation, and shells under irradiation. S.P.

N67-15558*# National Aeronautics and Space Administration, Washington, D. C.
THE VIBRATION BEHAVIOR OF CIRCULAR CONICAL SHELLS

Chao-Tsien Tang and Zhong-Yu Hong Nov. 1966 25 p refs Transl. into ENGLISH from Acta Mechanica Sinica (Communist China), v. 9, no. 1, Mar. 1966 p 14–26
(NASA-TT-F-10393) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Experimental methods and results of the vibrations of twenty conical shell specimens with various geometries and dimensions are presented and discussed. The vibration mode measured in these experiments indicates that it varies with the conical angle and the circumferential wave number. Such phenomena must be considered in choosing the admissible mode functions when direct methods are used for calculations of the eigen frequencies. Numerical results computed by the decomposition method and the Ritz method are given and compared quantitatively with the data of experiments. Curves for calculating the eigen frequencies of arbitrary complete conical shells by the decomposition method are presented for engineering application. Author

N67-15662*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PLASTIC BUCKLING OF AXIALLY COMPRESSED ECCENTRICALLY STIFFENED CYLINDERS
Robert M. Jones Washington, NASA, Jan. 1967 24 p refs
(NASA-TN-D-3769) CFSTI: HC $3.00/MF $0.65 CSCL 20K

A solution for the plastic buckling of axially compressed eccentrically stiffened cylinders is derived by use of the J_2 deformation theory of plasticity (maximum energy of distortion theory) for a set of simply supported edge boundary conditions. Many effects which have not been studied previously are included, and a closed-form stability criterion is obtained. Results are more realistic for practical stiffened cylinders than an existing solution. A numerical example is given to illustrate the effect of plastic action on the buckling load of a typical aerospace structure. Author

N67-15671*# Massachusetts Inst. of Tech., Cambridge.
ON THE DUALITY BETWEEN THE PROBLEMS OF STRETCHING AND OF BENDING OF PLATES, 16 MARCH–15 SEPTEMBER 1966
Z. M. Elias Washington, NASA, Jan. 1967 58 p refs
(Grant NGR-22-009-059)
(NASA-CR-705) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The duality between the dependent variables of the problems of stretching and of bending of plates was studied. Displacements, strains, and in-plane changes of curvature were included in the stretching problem; and stress functions, stress couples, and transverse shears were included in the bending problem. In both problems, the displacement and the stress function methods of solution, displacement and force boundary conditions, and simply and multipli-connected plates are considered. The problem of plane strain is not treated directly but can be obtained from the stretching problem by changing E into $E/1-\nu^2$ and ν into $\nu/1-\nu$ where E is Young's modulus and ν Poisson's ratio. The duality for anistropic plates is also outlined. The presentation of the stretching–bending analogy is made by specializing to the case of the plate general equations developed for a shell in orthogonal curvilinear coordinates. Cartesian coordinates are used but when needed formulas in curvilinear coordinates are specialized to the case of a curved boundary. Author

N67-15692*# National Aeronautics and Space Administration, Washington, D. C.
THEORY OF THE THREE-DIMENSIONAL STRESS STATE IN A PLATE WITH A HOLE [THEORIE VAN DE DRIEDIMENSIONALE SPANNINGSTOESTAND IN EEN DOORBOORDE PLAAT]
Johannes Bartholomeus Aiblas Jan. 1967 98 p refs Transl. into ENGLISH of a thesis submitted to the Tech. High School, Delft, Netherlands, 3 Jul. 1957 p 1–127
(NASA-TT-F-10451) CFSTI: HC $3.00/MF $0.65 CSCL 20K

For the special cases of stretching and bending of an infinite plate with a circular cylindrical hole, a rigorous analysis is developed. The method of investigation is based on the use of complex eigenfunctions, whose general theory was developed some years ago. It is the purpose of this investigation to examine the effect of the plate thickness on the stress distribution and to discuss the errors due to the approximate character of current two-dimensional theories. Author

N67-15771# Catholic Univ. of America, Washington, D. C.
COMPLETE DYNAMIC RESPONSE OF RATE-SENSITIVE STRUCTURES
Nicholas Perrone and Tamim El-Kasrawy Oct. 1966 28 p refs
(Contract NSF GK-782)
(Rept.-2)

A simplified general method, developed to determine the response of impulsively loaded perfectly plastic rate-sensitive structures with highly non-linear yield stress-strain rate laws, is extended to encompass the dynamic load application phase. In other terms, a mathematical model closer to the physical situation is considered, namely, a pressure loaded rather than an impulsively loaded structural element. As the prototype of a general structure the dynamically loaded thin ring is considered. For a constant pressure pulse, exact and approximate responses are calculated and differ by only a few percent. In the approximate solution the yield stress is taken to be a constant associated with the peak strain rate (which occurs at the instant of load termination). The results suggest that one should be able to determine the complete response of a complex structure with arbitrary load pulse by enforcing an impulse/momentum change condition, while neglecting forces arising owing to deformation, to determine the initial strain rate distribution. The associated yield stress distribution may be calculated and assumed to be constant at each field point during the entire motion. Author

N67-15791*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ENVIRONMENTAL AND PHYSICAL EFFECTS ON THE RESPONSE OF BALSA WOOD AS AN ENERGY DISSIPATOR
A. C. Knoell *In its* Space Programs Sum. No. 37–40, Vol. 4 31 Aug. 1966 p 33–34 (See N67-15781 08-34) CFSTI: HC $3.00/MF $0.65

A summary of the effects of temperature, pressure, and moisture content on the energy-dissipating capacity of balsa wood is presented. The findings indicate: (1) Specific energy dissipation and crushing stress of the balsa wood increased with decreasing moisture, decreasing temperature, and increasing density. (2) Environmental pressure has little effect on response. (3) A temperature dependence exists to a specific energy–moisture content relationship developed for balsa wood. M.G.J.

N67-15792*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
CONTINUING DEVELOPMENT OF PHENOLIC HONEYCOMB AS AN ENERGY DISSIPATOR
A. C. Knoell *In its* Space Programs Sum. No. 37–40, Vol. 4 31 Aug. 1966 p 34–35 refs (See N67-15781 08-34) CFSTI: HC $3.00/MF $0.65

Results obtained in a program designed to improve the energy dissipating characteristics of phenolic honeycomb are reported. The most significant development is identified as the use of a thin dip technique for resin building on the honeycomb glass cloth

core. Tests conducted statically and at an impact velocity of 50 ft/sec showed that the improved specimens crush uniformly, with no evidence of separation at the node bond line. Other findings show: (1) Resin cure temperature has a definite effect on the crushing strength of phenolic honeycomb in that the lower cure temperatures result in lower values of specific energy dissipation. (2) A prefailed depth of approximately 0.3 in. is required to insure that the initial peak force will not exceed the quasi-steady state crushing force of phenolic honeycomb. M.G.J.

N67-15893*# Southwest Research Inst., San Antonio, Tex.
VERTICAL EXCITATION OF PROPELLANT TANKS
Franklin T. Dodge *In its* Dyn. Behavior of Liquids in Moving Containers 1966 p 269–301 refs (See N67-15884 06-12)
GPO: HC $2.75; CFSTI: MF $0.65

The various aspects of liquid behavior in response to vertical excitations of the propellant tank are discussed. Topics are discussed relating to: 1) the subharmonic response (i.e., liquid response with a frequency less than that of the excitation) of the liquid surface to fairly low frequency excitations, with detailed comparisons made between theory and the results of laboratory experiments; 2) liquid spray formed at the free surface because of relatively high frequency excitation; and 3) the aspects of bubble dynamics and cavitation observed in laboratory studies. Author

N67-15894*# Southwest Research Inst., San Antonio, Tex.
INTERACTION BETWEEN LIQUID PROPELLANTS AND THE ELASTIC STRUCTURE
Daniel D. Kana *In its* Dyn. Behavior of Liquids in Moving Containers 1966 p 303–352 refs (See N67-15884 06-12)
GPO: HC $2.75; CFSTI: MF $0.65

The influence of a liquid in modifying the vibration characteristics of an elastic shell is discussed without considering coupling and as a result only of the added mass. Both bending and breathing type vibrations are considered. The coupled problem is treated and interesting forms of liquid response induced by tank wall elastic vibrations are discussed. The influence of the elastic bottom of the tank is examined with respect to the vertical sloshing problems. The effects of body bending flexibility on the general problem of vehicle stability and control are outlined. Author

N67-15895*# Southwest Research Inst., San Antonio, Tex.
LIQUID IMPACT ON TANK BULKHEADS
John F. Dalzell *In its* Dyn. Behavior of Liquids in Moving Containers 1966 p 353–372 refs (See N67-15884 06-12)
GPO: HC $2.75; CFSTI: HC $0.65

The problem of tank bulkhead rupture by fluid impact due to thrust termination in the atmosphere is considered. Some estimates of the conditions imposed on the tank fluid by thrust termination are given. Experimental liquid impact studies are summarized, some of the conclusions are reviewed, and a gross comparison is made of the results. R.N.A.

N67-15938# Lockheed Missiles and Space Co., Palo Alto, Calif.
NONLINEAR SHELL EQUILIBRIUM EQUATIONS
V. M. Darevskii [1966] 4 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 170, no. 3, 1966 p 537–539

Nonlinear equilibrium equations are used in the investigation of shell stability. They take account of changes in the middle surface of the shell subjected to loading. General shell equilibrium equations which are obtained if rotation, elongation and shear are taken into account, are presented below. They refer to both the fundamental cases: when the surface loading is conservative or when it is a following loading. Author

N67-15963# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science.
ON THE UNIQUENESS OF THE SOLUTION TO ELASTOSTATIC BOUNDARY-VALUE PROBLEMS FOR THE HALF-SPACE
Matias J. Turteltaub and Eli Sternberg Oct. 1966 20 p refs
(Contract Nonr-220(58))
(TR-8; AD-641657) CFSTI: HC $3.00/MF $0.65

Uniqueness theorems are established appropriate to the classical elastostatic boundary-value problem for a half-space under given surface displacements or surface tractions. These theorems assure the uniqueness of the solution in the absence of artificial apriori requirements concerning its behavior at infinity. Author (TAB)

N67-16000# Brown Univ., Providence, R. I. Div. of Engineering.
NORMALITY RELATIONS AND CONVEXITY OF YIELD SURFACES FOR UNSTABLE MATERIALS OR STRUCTURAL ELEMENTS
A. C. Palmer, G. Maier, and D. C. Drucker Sep. 1966 40 p refs
(Contract Nonr-562(20))
(Nonr-562(20)/49; TR-49; AD-640963) CFSTI: HC $3.00/MF $0.65

The stress-strain relations for materials and the load-deflection relations for structural elements play corresponding roles in the analysis of three-dimensional continua and of structures respectively. Mathematically equivalent and phenomenologically quite similar, they are treated simultaneously here. As in previous treatments of stable (rising) plastic stress-strain curves, unstable (falling) curves in simple shear or tension are generalized to all states of stress through the exploration of the work done in a cycle of stress (Drucker) and in a cycle of strain (Ilyushin). The plastic increment of strain is found to be normal to the current yield surface for a wide class of unstable materials in which a continuous variation of strain produces a unique continuous variation of stress and of the shape and position of the yield surface. In the absence of any significant alteration in the (stable) elastic response, each yield surface then is shown to be convex. The degree of concavity possible when the elastic response is stable but is non-linear and does alter appreciably due to plastic deformation is illustrated by a non-linear elastic spring and a plastic block in parallel. Such concavity would not be observable in the yield surfaces of common structural metals, but might be found for soils, rocks or concrete and can be quite pronounced for structural elements. Author (TAB)

N67-16046*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SELF-EVACUATED MULTILAYER INSULATION OF LIGHTWEIGHT PREFABRICATED PANELS FOR CRYOGENIC SPACE PROPULSION VEHICLES
P. J. Perkins, R. P. Dengler, L. R. Niendorf, and G. E. Nies (Union Carbide Corp., Tonawanda, N. Y.) Washington, NASA, 1967 18 p refs To be presented at the 8th Struct., Structural Dyn. and Mater. Conf., Palm Springs, Calif., 29–31 Mar. 1967; Sponsored by AIAA
(NASA-TM-X-52266) CFSTI: HC $3.00/MF $0.65 CSCL 22B

A concept for simplifying the application of radiation shield insulation to propellant tanks was developed and tested for both ground and space performance. Vacuum-tight flexible casing material of laminated aluminized Mylar encloses the multilayers forming panels that are bonded to tank walls in an overlapping shingle arrangement. The panels with CO_2 gas which cryopumps to provide required vacuum when the tank is filled with a cryogen. Thermal performance of insulation was determined in flat plate and cylindrical calorimeters. During ground-hold tests, insulation

panels as large as 3- by 6-ft mounted on a cylindrical calorimeter of liquid hydrogen, cryopumped down to at least 5×10^{-3} torr and resulted in a heat flux of 23 Btu/(hr)(sp ft) for an external temperature of 70°F. In simulated space tests, panels evacuated by outside vacuum resulted in a heat flux of 0.86 Btu/(hr)(sq ft) with outside surfaces at 70°F. Author

N67-16108# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Aero Propulsion Lab.
EXPANDABLE AND MODULAR STRUCTURES TECHNOLOGY FOR SUPPORT OF MANNED MISSIONS
Fred W. Forbes and Michael I. Yarymovych (NASA, Washington) 1966 16 p Presented at the 17th Intern. Astron. Federation Congr., Madrid, 10–15 Oct. 1966
(AFAPL-CONF-67-5; AD-641903) CFSTI: HC $3.00/MF $0.65

The most current technology for expandable and modular structures with direct emphasis on the immediate and future application to manned space missions is presented. The scope is limited to the following: a brief review of key historical accomplishments, major results of research efforts in expandable and modular structures, and immediate and longer range manned applications for these structures. Author (TAB)

N67-16138# Naval Ordnance Lab., White Oak, Md. Explosion Dynamics Div.
ON THE POSSIBILITY OF A PRECURSOR MEMORY EFFECT IN CRYSTALLINE SOLIDS
Paul Harris 16 Sep. 1966 17 p refs
(NOLTR-66-175; AD-641203) CFSTI: HC $3.00/MF $0.65

A simple qualitative model is developed for the existence of a precursor memory effect. By using our model we investigate Taylors prediction of a memory in Armco iron and conclude that his theory leading to the memory prediction is incomplete in that it neglects viscous effects occurring in the precursor shock front region and plasticity contributions to the stress. When such effects are incorporated into the theory the amount of memory is shown to be diminished. Author (TAB)

N67-16334# Aerophysics Co., Washington, D. C.
INVESTIGATION OF LIGHTWEIGHT STRUCTURAL DESIGN TECHNIQUES FOR LIGHTWEIGHT FANS Technical Report, Nov. 1964–Feb. 1966
G. Boehler, W. Foshag, E. Deutsch, and J. Balciunas Ft. Eustis, Va., Army Aviation Materiel Labs., Sep. 1966 145 p refs
(Contract DA-44-177-AMC-250(T))
(USAAVLABS-TR-66-60; AD-640988) CFSTI: HC $3.00/MF $0.65

The results of an investigation of the design and fabrication problems of a minimum-weight rotating-diffuser lift system for an air cushion vehicle (ACV) are presented. A numerical method for the stress analysis of an indeterminate rotating diffuser centrifugal fan structure was reduced to practice and programmed for the IBM 1620 computer. This method was used as a tool for the analytical design of a minimum-weight RD fan. The fan, with a 64.5-inch overall diameter, was built of aluminum and was structurally tested. Stress levels throughout the fan were measured by means of 21 strain gages. Results of the tests are very encouraging and vindicate the analytical approach to fan design. Based on measured weights and stress levels, it is concluded that RD fans for ACV applications, for ratings between 100 and 1000 horsepower, can be built for 0.5 pound per horsepower. Author (TAB)

N67-16375# Allied Research Associates, Inc., Concord, Mass.
AN EXPERIMENTAL INVESTIGATION OF DEEP SUBMERGENCE WINDOWS Final Report
Robert Winter 10 Oct. 1966 58 p refs
(Contract NObs-94102)
(ARA-315-10; AD-640707) CFSTI: HC $3.00/MF $0.65

An experimental study was conducted on 90 degree conical plexiglas deep submergence window models in the range of small diameter/thickness ratio of 0.5 to 2.5. Several windows were tested under short term high pressure loadings, one was subjected to a 30 day creep test, and some models were fully submerged under high hydrostatic pressures. There were preliminary indications that improved structural performances could be obtained by recessing the model in its seat at the inner face, and that the strength of the windows may be affected by rapid loading or unloading rates. Small elastic creep deformations were found at 2,000 psig over 30 days for d/h = 1.0. The very high hydrostatic pressures had no observable effect on the windows. Author (TAB)

N67-16390# California Univ., Livermore. Lawrence Radiation Lab.
EXPANSION OF A CUTTING TOOL DURING CHIP REMOVAL
James B. Bryan, Richard W. Clouser, and Eldon R. McClure 21 Jul. 1966 7 p ref
(Contract W-7405-ENG-48)
(UCRL-50116) CFSTI: HC $3.00/MF $0.65

Stress caused by heat generation in infinite flat plates is investigated analytically and numerically by well-known methods. It is shown how these methods can be used to solve multiple-plate problems. The numerical method used allows one to consider very high–even instantaneous–heat-generation rates. A comparison is given between the analytical and numerical solutions. The problems are arranged in order from the simple to the more complex, and the methods, both analytic and numerical, are explained in detail so that an engineer with a minimum of mathematical training can understand them and use the results to solve similar problems. Author (NSA)

N67-16402# David Taylor Model Basin, Washington, D. C. Structural Mechanics Lab.
AN EXPLORATORY STUDY OF THE FEASIBILITY OF GLASS AND CERAMIC PRESSURE VESSELS FOR NAVAL APPLICATIONS Final Report
Thomas J. Kiernan Sep. 1966 36 p refs
(DTMB-2243; AD-641875) CFSTI: HC $3.00/MF $0.65

An exploratory study was conducted to determine the feasibility of using glass and ceramic materials for deep-submergence pressure hulls. In general, the study confirmed the potential use of these materials in pressure hulls capable of withstanding pressures at the deepest part of the ocean with very little structural weight. However, the study also showed that very little is known about the behavior of glass and ceramic structures under high-compressive loading and that a great deal of basic data must be generated before this potential can be achieved. The use of simple spheres of glass and ceramic materials for providing buoyancy is considered to be the most promising near-future application. Author (TAB)

N67-16426# Pennsylvania Univ., Philadelphia. School of Metallurgical Engineering.
THE EFFECT OF STRUCTURAL VARIABLES Annual Summary Report
Norman Brown 14 Oct. 1966 4 p refs
(Contract Nonr-551(56))
(AD-641259) CFSTI: HC $3.00/MF $0.65

Experimental effort was spent in trying to make a new microstrain apparatus work in compression at helium temperatures. The instrumental non-linearities in the load-deformation curve were removed by correcting small amounts of bending in the apparatus. Finally linearity but not retrace was obtainable where the lack of retrace was shown to be instrumental in origin and not depend on the specimen. TAB

N67-16480# Naval Ordnance Lab., White Oak, Md.
A STUDY OF THE ROLE OF MECHANICAL-STRENGTH PROPERTIES ON THE PHENOMENA OF SPALLATION
Robert Piacesi and James W. Watt 4 Jan. 1966 32 p refs
(NOLTR-66-42; Ballistics Res. Rept.-157; AD-641874) CFSTI: HC $3.00/MF $0.65

An experimental investigation was made to determine the role of mechanical-strength properties on the spallation phenomena due to hypervelocity impact. The size of the impacting particle and the thickness of the target were held constant, while the impacting velocity and the yield strength of the target were varied. The spall location, the magnitude of the shock wave arriving at the targets rear surface, and the amount of bulging of the spall piece were measured. The bulging could be predicted with theory to good agreement. TAB

N67-16543*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE VIBRATION RESPONSE OF AN ORBITING GEOPHYSICAL OBSERVATORY SPACECRAFT FULL-SCALE STRUCTURAL MODEL TO A SIMULATED LAUNCH ACOUSTIC ENVIRONMENT
Paul J. Alfonsi Aug. 1966 91 p refs
(NASA-TM-X-55640; X-320-66-353) CFSTI: HC $3.00/MF $0.65 CSCL 22B

The Orbiting Geophysical Observatory (OGO) acoustic test is described. In essence, the test item was an assemblage of a full-scale structural model of the OGO spacecraft, a flight-type shroud, and the forward equipment rack portion of an Agena B vehicle. The test article was subjected to a simulated launch acoustic environment which was generated by a 9 × 6 thermal structures wind tunnel. Vibration transducers were attached at pertinent locations on the spacecraft and adjacent structure, and the responses resulting from acoustic excitation were recorded on magnetic tape. Tape recordings were also made of microphone data pertinent to the acoustic environment. A total of 205 channels of data was acquired. This report presents a detailed discussion of the test program and a detailed analysis of all acquired data. Author

N67-16584# National Bureau of Standards, Washington, D. C.
COLLISIONS OF LIQUID DROPS WITH LIQUIDS. PART III: IMPACT CRATERING IN THE HYPERVELOCITY RANGE
Olive G. Engel Wright-Patterson AFB, Ohio, AF Mater. Lab., Jun. 1966 84 p refs
(Contract AF 33(657)-62-385)
(WADD-TR-60-475, Pt. III; AD-643237) CFSTI: HC $3.00/MF $0.65

Results of analysis of information obtained from photographs of a hypervelocity impact against a transparent target and from hypervelocity craters produced in impacts that involved the four possible projectile-target combinations of high-purity copper and aluminum are discussed. An equation for hypervelocity crater depth is derived. Hypervelocity crater depth data for the four possible projectile-target combinations of high-purity copper and aluminum are presented in table form and used in graphs to test the theoretical equations. Author (TAB)

N67-16639*# TRW Systems, Redondo Beach, Calif.
EXPERIMENTAL RESEARCH ON HYPERVELOCITY CRATERING BY MICROSCOPIC PARTICLES
J. C. Slattery Nov. 1966 83 p ref
(Contract NASw-1116)
(TRW-03246-6001-R000) CFSTI: HC $3.00 CSCL 20K

Described are the results of some hypervelocity cratering experiments with micron-sized particles, for comparison with data obtained with much larger particles. Cratering data is usually presented by plotting the crater diameter, D, normalized to the impacting particle diameter, d, as a function of impacting particle velocity. The depth of the crater, or penetration, P, may be used instead of crater diameter. The assumption made is that this normalization procedure (dividing by the particle diameter) removes any effect of particle size. Previous studies indicated that a better normalization factor might be the particle diameter raised to the (19/18) power instead of unity power. Using projectiles of 1/16 inch up to 1/2 inch diameter, a 1/6 power dependence on particle diameter was noted in the momentum transfer upon impact. By then taking the cube root of this correction an improved correlation in their cratering data was obtained. The 1/18 power correction obviously is a very small number unless particles of widely different sizes are being compared. The size ratio of TRW Systems particles (about 1 micron diameter) to the Ames particles (approximately 1 cm) is 10^4. Thus even a 1/18 power dependence on particle diameter should be observable. Author

N67-16663*# Lockheed Aircraft Corp., Sunnyvale, Calif.
DEVELOPMENT AND APPLICATION OF A PHOTOELASTO-PLASTIC METHOD TO STUDY STRESS DISTRIBUTIONS IN VICINITY OF A SIMULATED CRACK
A. R. Hunter and M. E. Schwarz Washington, NASA, Dec. 1966 142 p refs
(Contract NAS1-4760)
(NASA-CR-655) CFSTI: HC $3.00/MF $0.65 CSCL 11F

The proposed photoelasto-plastic method utilizes the creep and frozen stress characteristics exhibited by epoxy resins and other polymer materials when subjected to a thermal cycle whose maximum temperature is significantly less than the critical temperature of the material. The resulting frozen stress-strain behavior is characterized by the generation of nonlinear effective stress-strain curves. Effective stress-strain curves were generated for two polymer materials, an epoxy and a polycarbonate, for various thermal cycles in order to arrive at a material and associated thermal cycle which could be used to simulate the stress-strain behavior of an aluminum alloy. Also the associated birefringence was determined (calibration). Stress-strain similarity was established using the Ramberg-Osgood method. Upon selection of an appropriate model material and thermal cycle, elasto-plastic stress distributions were determined for infinite plates with centrally located holes to verify the usefulness of the method. This photoelasto-plastic method of stress analysis was then applied to study stress distributions in the vicinity of a simulated crack. Author

N67-16664*# Martin Co., Denver, Colo.
MULTIVARIABLE ANALYSIS OF THE MECHANICS OF PENETRATION OF HIGH SPEED PARTICLES
D. D. Bourne and W. C. Burkitt Washington, NASA, Dec. 1966 184 p refs
(Contract NAS7-219)
(NASA-CR-664) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Reported are results of a study to determine, by statistical analysis of the data available from the literature, those properties of projectile and target materials that influence the penetration of very high velocity projectiles. Experimental results from high-velocity impact of spherical projectiles on massive targets were chosen as the basis for this analysis. Considered were the usual physical and mechanical properties of metallic materials and their derivatives. Focused upon was the development of methods of extracting from the data the effects of variables (impact velocity and geometric parameters) other than projectile and target material properties. Prediction equations allowing quantitative estimates of the effect of material properties on crater depth and crater volume were developed. The procedure appears to be promising for the analysis

of bumpered target data. For bumpered targets the work from the literature on the effect of material properties was used as a basis for analyzing the relationship between bumper thickness, bumper spacing, and corresponding thickness of bumpered targets that will be penetrated. Although a multivariable analyses of the ballistic limit of single sheets was not possible, the study revealed the possibility that no discontinuity exists between the unbumpered case and that of very thin bumpers. S.C.W.

N67-16672*# Arizona State Univ., Tempe.
ON THE DYNAMIC CHARACTERISTICS OF A VARIABLE-MASS SLENDER ELASTIC BODY UNDER HIGH ACCELERATIONS
Leonard Meirovitch and Donald A. Wesley Washington, NASA, Feb. 1967 83 p refs
(Grant NGR-03-001-022)
(NASA-CR-713) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Mathematical formulations for studying the dynamic characteristics of a variable mass body moving through space, are presented. The model simulates a solid fuel rocket comprised of a cylindrical elastic shell, open at one end and closed at the other end, subjected to internal gas flow due to fuel burning. Differential equations of motion for the case and fluid elements are given. The combined differential equations of motion are given in vector form. The case of vertical, upright flight was solved by a closed form solution to study the dynamic characteristics of the boost vehicle. To determine the effect of the fluid flow on the missile dynamic characteristics, the internal pressure and velocity distributions were investigated for a body under high accelerations, considering the contribution of terms resulting from fluid flow, friction, and a noninertial control volume. To verify the solution for the axial deformations obtained by means of the perturbation technique, as well as to determine the effect of relaxing the requirement of linear rigid body translation, a numerical solution to the coupled equations of motion was obtained. Excellent correlation between the two solutions was obtained. L.S.

N67-16688*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
COMPRESSION TESTS OF OPEN-FACE TRUSS-CORE SANDWICH PANELS
George W. Zender Washington, NASA, Jan. 1967 23 p refs
(NASA-TN-D-3780) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The results of compression tests of 15 open-face truss-core sandwich panels are presented. The experimental buckling stresses are compared with those obtained by the use of orthotropic plate theory. The comparison shows that the open-face truss-core sandwich panel is substantially less efficient that indicated by orthotropic plate theory for panels with design stresses in the region of the local buckling stress. The inefficiency appears to be associated with the reduced stiffnesses near the edges of the panel where the supporting structure interrupts the ribs and core. Better performance might be obtained if the core and ribs of the open-face panel were extended continuously over the supporting structure. In addition, initial imperfections appear to have a significant effect upon the performance of open-face sandwich panels. Author

N67-16689*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
VIBRATION ANALYSIS OF CYLINDRICALLY CURVED PANELS WITH SIMPLY SUPPORTED OF CLAMPED EDGES AND COMPARISON WITH SOME EXPERIMENTS
John L. Sewall Washington, NASA, Jan. 1967 54 p
(NASA-TN-D-3791) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The natural frequencies of cylindrically curved panels are calculated by application of the classical energy method employing the Rayleigh–Ritz procedure and are compared with measured frequencies of rectangular and square panels fastened at their edges by means of closely spaced bolts. The mode shapes used in the calculations are products of functions based on beam vibration mode shapes and satisfying geometrical edge conditions in both longitudinal and circumferential directions. General frequency equations are derived, and their applications to panels of small curvature lead to simplified Rayleigh-type frequency equations which were more satisfactory for certain modal combinations and edge conditions than for others. Measured frequencies were, for the most part, bracketed by calculated frequencies based on simply supported or fully clamped edges and, at low-order circumferential modes, were generally closer to calculated frequencies for simply supported edges but showed some tendency to move closer to calculated frequencies for clamped edges as the circumferential mode number increased. This behavior is attributed partly to membrane effects due to panel curvature and partly to complicated edge conditions due to the use of simple lap attachments which could not be represented adequately by theory. Comparison of experimental frequencies with inextensional frequencies, calculated with longitudinal and/or circumferential membrane strains omitted, indicated that actual panel mountings may have provided greater edge fixity along curved rather than along straight edges. Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N67-15348# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
STUDY OF THE HEATING OF SOLIDS BY CONVECTIVE AND RADIANT FLUXES
V. V. Ivanov and A. V. Furman 17 Aug. 1966 11 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Energ. i Transp. (USSR), no. 1, 1966 p 131–134
(Contract NOw-62-0604-c)
(TG-230-T498; AD-640608) CFSTI: HC $3.00/MF $0.65

An approximate method is described for calculating the temperature field in solids heated by convection and radiation when the thermophysical properties of the substance (heat capacity and conductivity) depend on the temperature. Author (TAB)

N67-15385*# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
THE EFFECT OF SURFACE ROUGHNESS AND WAVINESS UPON THE OVERALL THERMAL CONTACT RESISTANCE
Borivoje B. Mikic, M. Michael Yovanovich, and Warren M. Rohsenow Oct. 1966 37 p refs
(Grant NGR-22-009-065)
(NASA-CR-81158; Rept.-76361-43) CFSTI: HC $3.00/MF $0.65 CSCL 20M

A thermal contact conductance equation was developed which considers both the effect of surface roughness and waviness. It was shown that the overall thermal contact conductance is determined by the roughness at large contact pressures or rough surfaces. It is also shown that surface roughness increases the contour radius

over that predicted by the theory of Hertz. The surface roughness influences the magnitude of the waviness resistances by spreading the load at the contact over a larger region. The theory was seen to be in very good agreement with experimental data. Author

N67-15414# Massachusetts Inst. of Tech., Cambridge. Aerophysics Lab.
RADIATIVE TRANSPORT IN CORNER FLOW Final Report
Roy S. Krupp Jul. 1966 63 p refs
(Contract NOw-65-0105-d)
(TR-124; AD-642520) CFSTI: HC $3.00/MF $0.65

The effects of radiative transport in corner flow are studied. A solution to the diabatic flow problem ph sub t = Q is found as a perturbation on the adiabatic Prandtl-Meyer solution. The solution is specialized to give asymptotic radiative effects at large and small distances from the corner within the expansion fan. Propagation of weak rotational disturbances through the turn is also described by this solution. A variation on the P. L. K. method is introduced to take the singular characteristics into account. Author (TAB)

N67-15439# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.
A GASDYNAMIC ANALYSIS OF THE COUNTER-FLOW DIFFUSION FLAME IN THE FORWARD STAGNATION REGION OF A POROUS CYLINDER
Hiroshi Tsuji and Ichiro Yamaoka Jul. 1966 25 p refs *Its* Vol. 31, No. 5
(ISAS-404) CFSTI: HC $3.00/MF $0.65

A gasdynamic analysis is made on the counter-flow diffusion flame established in the forward stagnation region of a porous cylinder, from the surface of which the fuel gas is ejected uniformly into the uniform air stream, and the effects of the aerodynamic and chemical parameters upon the location of the flame are examined. The flow, concentration and temperature fields are analyzed on the flame sheet model and by the boundary layer approximation. The general analytic expression for the between the location of the flame and the fuel ejection rate is obtained, and the location of the flame is determined for various combinations of reactants by a simple calculation. Some of these theoretical results are compared with the experimental results observed by the present authors. It is found that the theoretical results are qualitatively consistent with the observed results, and therefore, the flame sheet model is useful to evaluate the effects of the aerodynamic and chemical parameters upon the location of the flame, although the blow-off limit of the flame observed in the experiment can not be predicted by the flame sheet model in which the infinite rate of reaction is assumed in the flame zone. Author

N67-15718*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LOW-PRESSURE COMBUSTION STUDIES
L. Strand *In its* Space Programs Sum. No. 37-41, Vol. IV 31 Oct. 1966 p 85-91 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

The experimental propellants used in low pressure combustion studies are listed, and tests were conducted to determine the motor L* and chamber pressure at the onset of instability (OI). It was found that the OI boundary approaches the extinction boundary as the propellant aluminum/oxidizer concentration ratio is reduced. In measuring the pressure oscillation rate of depressurization, a definite correlation was found between the rate of depressurization and the mean chamber pressure prior to extinction. Motion picture film and oscillograph pressure data from tests with several different propellant formulations were also correlated. Indications are that the events leading to complete combustion extinction consist of the onset of extinction; a rapid decrease in propellant gasification; extinction; and chamber venting. M.G.J.

N67-15730*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RESONANT COMBUSTION
R. M. Clayton, J. W. Woodward, and J. G. Sotter *In its* Space Programs Sum. No. 37-41, Vol. IV 31 Oct. 1966 p 134-151 (See N67-15701 06-11) CFSTI: HC $3.00/MF $0.65

Liquid rocket propulsion studies were conducted on: (1) the behavior of the pressure wave during its rotation about the chamber circumference; (2) combustion processes, under resonant conditions, within the chamber volume; and (3) hydrodynamic response of the injection scheme to high amplitude chamber pressure oscillations. Also reported briefly are circumferential variations in the resonant pressure wave, development of diagnostic techniques to monitor the combustion process in some flight engines, and the response of injectors to high-amplitude oscillations. R.Ll.

N67-15788*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE EFFECT OF UNCERTAINTIES IN TRANSPORT PROPERTIES ON PREDICTION OF STAGNATION POINT HEAT TRANSFER
D. W. Zeh and T. E. Horton *In its* Space Programs Sum. No. 37-40, Vol. 4 31 Aug. 1966 p 27-28 (See N67-15781 06-34) CFSTI: HC $3.00/MF $0.65

Studies were undertaken to confirm previous findings that the significant differences existing in transport properties can effect predicted flow and convective heating in the complicated case of the stagnation region of an axisymmetric blunt body. The flow was assumed to be laminar in chemical equilibrium, and described by the compressible form of the boundary layer equations with real gas effects accounted for by use of the total property concept. Viscous dissipation and work of compression were ignored. The equations were solved by interative numerical technique for a wall temperature of 1000°K and a stagnation pressure of 1 atm, using three different sets of transport properties for air. As the thermodynamic properties, solution technique, and transport properties near the wall temperature were influenced only by differences in the high temperature transport properties. The effect of transport properties on the stagnation point convective heat transfer in air is plotted, and it is seen that the maximum difference in predicted heat transfer is about 20%. M.G.J.

N67-15789*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMPARISON OF ENTRY-BODY SHAPES FOR TOTAL EQUILIBRIUM RADIATION UNDER MARS ENTRY CONDITIONS
H. J. Stumpf *In its* Space Programs Sum. No. 37-40, Vol. 4 31 Aug. 1966 p 28-31 (See N67-15781 06-34) CFSTI: HC $3.00/MF $0.65

Summary data are presented on an experiment designed to measure and compare the total (over the whole body) equilibrium shock layer radiative heat transfer for three entry body shapes in a simulated Mars atmosphere. The entry body shapes are the blunt cone, modified Apollo, and tension shell. The flight conditions to be simulated correspond to those encountered in typical hyperbolic Mars entry trajectories where maximum stagnation point convective or radiative heat transfer occur. The experimental total radiation results are to be obtained by a combination of measurements in a ballistic range, a shock tube, and a shock tunnel; the methods and procedures for each test facility are discussed. Preliminary indications from the ballistic range tests are that the modified Apollo shape is subject to much higher equilibrium shock layer radiation than either the blunt cone or tension shell. M.G.J.

N67-15797*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
LITHIUM-BOILING POTASSIUM RANKINE CYCLE HEAT-TRANSFER DATA

G. M. Kikin *In its* Space Programs Sum. No. 37-40, Vol. 4 31 Aug. 1966 p 50-63 (See N67-15781 06-34) CFSTI: HC $3.00/MF $0.65

Summary data are presented on the lithium boiling potassium test loop operations, which are being conducted in an attempt to simulate the major elements and working fluids of the two-loop nuclear turboplant concept for spacecraft propulsion. Boiling of potassium in stable and unstable modes has been carried on for a total accumulated time of approximately 40 hours at power levels of 20 to 30 kw, and at temperatures of 1600° to 1900°F. Among the pertinent loop component and behavioral experiences observed are: (1) Outgassing of the loop and attainment of satisfactory moisture and hydrogen levels was achieved following application of the argon purifier for on-stream purification. (2) Prevention of lithium pump impeller seizures was accomplished by shimming the impeller up a total of 0.040 in. This corrected for differences in impeller and pump casing growth during heating. (3) Considerable attention must be given to liquid metal valve design and manufacture, including operating mechanisms. (4) Potassium wetting of the neobium pump coils resulted in increasing the pump performance to a level which was ≈5% greater than its nominal design head-flow characteristic. M.G.J.

N67-15995# Library of Congress, Washington, D. C. Aerospace Technology Div.

AN EXPRESSION FOR THE BURNING VELOCITY IN SIMULTANEOUS HOMOGENEOUS AND HETEROGENEOUS REACTIONS Translations of Foreign Scientific and Technical Literature

Paul Vantoch 1 Aug. 1966 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 168, no. 4, 1966 p 844-845

(ATD-66-98; AD-641866) CFSTI: HC $3.00/MF $0.65

In the combustion of many systems, apart from the homogeneous reaction, a heterogeneous reaction can also take place on the particles which are either specially introduced into the system (catalytic or energetic additives) or are formed during the combustion process, e.g., soot. Consideration is given to the case when the heterogeneous reaction takes place in a diffusion regime, i.e., when the velocity is limited by the rate at which the reagents are transported to the surface of the particles. TAB

N67-16044*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

AN EXPERIMENTAL INVESTIGATION OF BOILING IN NORMAL AND ZERO GRAVITY

Thomas H. Cochran, John C. Aydelott, and Charles M. Spuckler Washington, NASA, 1967 14 p refs Presented at the Inst. of Environ. Sci. Ann. Meeting, Washington, 10-12 Apr. 1967

(NASA-TM-X-52264) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The effects of gravity on boiling from a flat horizontal surface is investigated in the heat flux range defined as the discrete bubble region for various subcoolings, fluid properties and heat transfer rates. The zero gravity data were obtained by allowing the experimental package to free fall in a 100 foot drop tower, which permitted the attainment of less than 10^{-5} times earth gravity. Data taken from high speed motion pictures indicated that boiling was independent of gravity at high subcooling and that the transition from the discrete bubble region occurred at a lower heat flux in zero gravity than in normal gravity. Application of an analysis to the data indicated that a newly defined pressure force was of major importance in bringing about bubble separation. Author

N67-16145# Princeton Univ., N. J. Gas Dynamics Lab.

KINETIC THEORY OF THERMAL CONDUCTIVE IN A COLLISIONLESS GAS

Yau Wu Wright-Patterson AFB, Ohio, ARL, Jun. 1966 34 p refs

(Contract AF 49(638)-1271; Grant NSF GK-59)

(ARL-66-0114; Rept.-746; AD-640872) CFSTI: HC $3.00/MF $0.65

The kinetic theory of thermal conduction in a collisionless gas in an arbitrary closed system was developed. The pressure, density, temperature and isotropicity (I) in the system are not uniformly distributed in general, but PI/square root of T and n (square root of TI) are invariants throughout the whole region according to the revised law of thermal transpiration developed recently by Wu. The thermal conductance was defined as a matrix in a multicomponent system. It is not only linearly dependent on the mean density in the system at a given temperature distribution on the boundary, but is also dependent on the geometry and the reflection law on the boundary of the system. Several geometries were considered, such as parallel plates, triangular parallel plates, cubes, polygons, polygonal parallel plates and others. A similarity law was established showing equivalence among the systems of different geometries. Author (TAB)

N67-16380# RAND Corp., Santa Monica, Calif.

EFFECT OF VOLUMETRIC ABSORPTION COEFFICIENT ON ROSSELAND RADIATIVE HEAT TRANSFER

R. L. Spicer Nov. 1966 14 p refs

(P-3061-1; AD-641954) CFSTI: HC $3.00/MF $0.65

In calculating the temperature profile and heat transfer associated with an optically dense fluid it has been the practice to use Rosseland's approximation for the radiative heat flux, since its form lends itself well for use in partial differential equations. However, very little is known about the form of the absorption coefficient which is the fluid-characteristic term in the approximation. It is revealed in the analysis that in the case of uniform fluid (optically dense) flow past a flat plate, the calculated temperature profiles and heat transfer to the wall by radiation alone are sensitive to the choice of the form of the absorption coefficient. Author (TAB)

N67-16446# Instituto Nacional de Tecnica Aerospacial, Madrid (Spain).

RECENT RESEARCH IN SUPERSONIC COMBUSTION AT INTA

Ignacio De Riva and Jose Luis Urrutia [1966] 15 p refs Presented at the 17th Intern. Astronautical Congr., Madrid, 9-15 Oct. 1966

(Grants AF-EOAR-62-91; AF-EOAR-63-43; AF-EOAR-65-69; AF-EOAR-66-41)

(AFOSR-66-2479; AD-641758) CFSTI: HC $3.00/MF $0.65

The paper summarizes the status of recent analytical studies on the fundamental aspects of the diffusional mode of supersonic combustion. Emphasis is on the use of the hydrogen-air (or hydrogen-oxygen-diluent) fuel oxidizer system. Included are discussions of (1) diffusion flames assuming (a) infinite chemical reaction rates and (b) comparable chemical reaction and diffusion rates, (2) premixed flames, and (3) the feasibility of improving aerodynamically the mixing process and diminishing the induction distance. Author (TAB)

N67-16455# Oklahoma Univ., Norman.

EXPERIMENTAL STUDY OF RADIATIVE HEAT TRANSFER BETWEEN PARALLEL PLATES Interim Technical Report, Feb. 1964-Sep. 1965

Tom J. Love and Joel S. Gilbert Wright-Patterson AFB, Ohio, ARL, Jun. 1966 136 p refs

(Contract AF 33(657)-8859; Grant NSF GP-360)

(ARL-66-0103; AD-643307) CFSTI: HC $3.00/MF $0.65

An apparatus was constructed for the experimental determination of radiative heat transfer between parallel plates. Two plates, approximately twelve inches square, were mounted in a vacuum system. One plate was electrically heated and the other was cooled by circulating water. A guarded heater section was constructed at the center of the hot plate so that the radiative flux at the center could be metered. The distance separating the plates was adjustable. Both plates were faced with prepared stainless steel in order to standardize the measurements. The surface was sandblasted so that the radiation was approximately diffuse. Measurements were made over a range of hot plate temperatures ranging up to approximately 750F. Plate spacings ranged from 0.5 inches to 3.0 inches. Measurements were in good agreement with computations based on the assumption of infinite gray plates for the 0.5 inch spacing. By enclosing the edges of the plates with foil reflectors, the measurements indicated agreement with the infinite gray plate assumption at 1.0 inch separation and reasonable agreement to 3.0 inch separation. Use of the apparatus for measurement of radiative heat transfer between the plates with a cloud of scattering dust separating the plates is discussed. Author (TAB)

N67-16513*# General Electric Co., Philadelphia, Pa.
EXPERIMENTAL STUDY OF EQUILIBRIUM AIR TOTAL RADIATION
J. S. Gruszczynski and W. R. Warren 31 Aug. 1965 22 p refs
(Contract NASw-1303)
(NASA-CR-81255) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Current studies in the field of thermal radiation from entry body flow fields are reviewed. Included in the program are vacuum UV predictions for N_2–CO_2 mixtures and for air (which were used to show that air and N_2–CO_2 mixtures have similar radiance properties at high velocities). Also considered is the interpretation of entry mission radiative heating including the UV contributions. The potential importance of vacuum UV radiance for the superorbital Earth entry of blunt bodies is stressed. Another important aspect is extension of investigations to the 60,000 ft/sec simulated velocity level to study the effects of convective-radiative energy coupling. The existence of a satisfactory test flow at this energy level is discussed. S.P.

N67-16556*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE THERMAL CONDUCTION PROCESS IN CARBONACEOUS CHARS
Robert G. Nagler 1 Feb. 1967 19 p refs
(Contract NAS7-100)
(NASA-CR-81295; JPL-TR-32-1010) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Conductive heat transfer in porous carbonaceous chars was considered in relation to the extent of char graphitization due to the time-temperature history of a particular degraded phenolic nylon sample. The available data on the conductance of phenolic nylon chars were analyzed and their practical value in application to entry or propulsion thermal protection systems was estimated. Measured values of conductance appear conservative for atmospheric entry or one-shot propulsion devices, but nonconservative for propulsion devices with several restarts. Chars can be tailored to produce the best attainable insulation capability or the strongest char, but not both. A compromise is necessary to combine both properties. Author

N67-16567*# Lockheed Missiles and Space Co., Palo Alto, Calif.
CONVECTIVE AND RADIATIVE HEAT TRANSFER TO AN ABLATING BODY, PART I Final Report
H. Hoshizaki and L. E. Lasher Jul. 1966 79 p refs
(Contract NAS7-386)
(NASA-CR-73060; LMSC-4-06-66-12) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The convective and radiative heat transfer to entry vehicles protected by ablation heat shields is investigated. The effects of mass injection, radiative emission and absorption, radiation cooling, and coupling between convection and radiation are included. The absorption coefficients of the shock layer gas, including the pyrolysis products species, are determined as a function of particle number density, temperature, and radiation frequency. An integral method is used to obtain an approximate solution to the momentum equation which yields the velocity profiles used to solve the species continuity and energy equations. The latter two equations are solved numerically by a finite difference method. Results for the shock layer structure and convective and radiative heating indicate that the absorption of the molecules added by ablation does not significantly affect the radiative heat flux to the surface; this was true for mass injection rates up to 5% of the free stream mass flux. Author

N67-16568*# Lockheed Missiles and Space Co., Sunnyvale, Calif. Aerospace Sciences Lab.
EMISSIVITY COATINGS FOR LOW-TEMPERATURE SPACE RADIATORS Quarterly Progress Report, 1 Jul.–30 Sep. 1966
J. R. Grammer 30 Sep. 1966 41 p refs
(Contract NAS3-7630)
(NASA-CR-72130; QPR-5) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Efforts in evaluating the solar absorptance and total hemispherical emittance of candidate coatings for low temperature spacecraft radiators are summarized. Work completed this period included 500 hr ultraviolet exposure tests of ZnO/silicone S-13 and S-13G coatings and a ZnO/K_2SiO_4 coatings, as well as both 500 and 100 hr ultraviolet exposure tests of a $ZrSiO_4/K_2SiO_4$ coating. Details of the test activities and results are discussed. R.N.A.

N67-16569*# Pratt and Whitney Aircraft, East Hartford, Conn.
DETERMINATION OF THE EMISSIVITY OF MATERIALS Semiannual Progress Report, 15 May–14 Nov. 1966
W. L. Luoma and R. C. Emanuelson 20 Dec. 1966 28 p
(Contract NAS3-4174)
(NASA-CR-72149; PWA-2979) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The testing of two stainless-steel tubes coated with iron titanate and calcium titanate was continued at 1350°F. Total test times accumulated were 19,245 hours for the calcium-titanate-coated specimen and 18,330 hours for the iron-titanate-coated specimen. The emittance of both specimens continues to remain steady at 0.88. Some separation of the iron-titanate coating has occurred during the past 4000 hours at the ends of the specimen and around the black-vody holes. Two 5000-hour thermal cycling tests were started for columbium-1% zirconium tubes coated with iro titanate. One specimen is being cycled between 1500 and 1800°F, and the second between 1500 and 1900°F. The first specimen has accrued 2100 hours of testing and 1310 thermal cycles. The second has accrued 1440 hours of testing and 900 thermal cycles. Both specimens have stable emittances between 0.38 and 0.90, and no changes in the appearances of the specimens have occurred. Author

N67-16570*# General Electric Co., Cincinnati, Ohio.
COMPUTER CODES FOR THERMAL DESIGN OF POTASSIUM BOILERS AND CONDENSERS
D. R. Ferguson 1966 120 p refs
(Contract NAS3-2528)
(NASA-CR-72141; R66SD3017) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Calculation procedures and computer codes for the thermal design of multiple-tube potassium condensers and boilers are presented. The condenser code provides for using either sodium, lithium or NaK as the shell-side cooling fluid. The main output from the condenser code is the condenser tube length required to satisfy specified design-point conditions. Additional output includes the local values of vapor quality, potassium temperature and pressure, and thermal parameters such as the local heat flux and heat transfer coefficients along the condenser tubes. The boiler code uses either liquid sodium or lithium as the shell-side heating fluid. The main output from the boiler code is the boiler tube length required to satisfy specified design-point conditions. The boiler code is based on using overall average values for the potassium boiling heat transfer coefficient from 0% to 100% quality. Both the condenser code and the boiler code are programmed in Fortran IV, and the source languages are compatible with either the IBM-7094 or the G.E.-625/635 machines. Author

N67-16571*# Lockheed Missiles and Space Co., Palo Alto, Calif.
CONVECTIVE AND RADIATIVE HEAT TRANSFER TO BLUNT BODIES AT ANGLE OF ATTACK, PART II Final Report
H. Hoshizaki Jul. 1966 62 p refs
(Contract NAS7-386)
(NASA-CR-73061; LMSC-4-06-66-11) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The convective and radiative heat transfer to blunt bodies at large angles of attack is investigated. In the analysis the shock shape is assumed to be a known quantity. Approximate solutions to the integrated tangential and azimuthal momentum equations are used to determine the shock layer velocity profiles. A finite difference type method is used to solve the energy equation. A crucial assumption made in the analysis is that the crossflow is locally similar. This assumption reduces the general three-dimensional problem to a two-dimensional one where the azimuthal angle appears as a parameter. The solution yields the convective and radiative heat transfer distribution as well as the detailed structure of the shock layer. The radiative heat transfer is evaluated spectrally taking into account the coupling between the flow field and the radiation transport. Typical results for one flight condition are presented. Author

N67-16646# Toronto Univ. (Ontario). Lash Miller Chemical Labs.
ENERGY DISTRIBUTION IN FLAMES AND ELECTRICAL DISCHARGES Final Report
Jacques M. Deckers Aug. 1966 97 p refs
(Grant AF-AFOSR-375-65)
(AFOSR-66-2132; AD-640705) CFSTI: HC $3.00/MF $0.65

It is shown that at low pressures the spectrum of the CH* and C2* emission is independent of flame parameters. Hence, the initial energy distribution is obtained. This energy distribution is then used to prove that the more than one reaction produces CH* in the ethylene flame. A theory is presented taking into account inelastic and reactive collision in the positive column of a DC glow discharge. The structure of the positive column near the anode is also analysed. A survey is presented of DC glow discharges through oxygen. Author (TAB)

N67-16686*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
A SURVEY OF THERMAL RADIATION STUDIES OF ABLATING BODIES IN THE BALLISTIC RANGE
William A. Page Washington, NASA, Feb. 1967 23 p refs
(NASA-TN-D-3741) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The radiative properties of the boundary layer and near wake of ablating bodies flying in ballistic ranges are studied. The ablating materials investigated include polycarbonate, resin, polyethylene, polyformaldehyde, Teflon, and cellulose nitrate. Both absolute radiometric and spectrographic data were obtained. The observed absolute amount of radiation varied greatly for the various materials. The chemical species responsible for the radiation in the spectral range from 0.2 to 1.1μ were CN, C_2, NH, H, and solid carbon microparticles, or soot. The results of the tests indicate a strong correlation between the radiating species present and the carbon-oxygen ratio of the ablating material. Author

N67-16687*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ARC-TUNNEL EVALUATION OF SOME ABLATIVE HEAT SHIELD MATERIALS FOR THE X-15-2
Andrew J. Chapman and Marvin B. Dow Washington, NASA, Feb. 1967 110 p refs
(NASA-TN-D-3753) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Fourteen ablation materials have been investigated at test conditions simulating the heating predicted for the X-15-2 research aircraft. Twenty-seven wedge-shaped models with a leading-edge radius similar to the X-15-2 wing and horizontal stabilizer leading edges were tested in the 2-inch supersonic arc tunnel. The ablation materials were exposed to the heating conditions which will occur on the X-15-2 leading edges and fuselage areas at an altitude of 105,000 feet (32 kilometers)and at Mach number 8. The results presented include back surface temperature response at several locations on the models and photographs of the models before and after testing. Author

N67-16690*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MECHANICAL ABSORPTION OF ACOUSTIC OSCILLATIONS IN SIMULATED ROCKET COMBUSTION CHAMBERS
Bert Phillips and C. Joe Morgan Washington, NASA, Jan. 1967 55 p refs
(NASA-TN-D-3792) CFSTI: HC $3.00/MF $0.65 CSCL 21B

Resonant absorbers to damp combustion oscillations in rocket motors were simulated by cold-flow tests. Acoustic waves were used to evaluate single Helmholtz resonators and perforated liners in a cylindrical test chamber. The first standing and spinning tangential, second standing tangential, and first radial were the wave modes tested. The geometrical parameters studied were liner-hole diameter, liner thickness, liner-back distance, and partitions in the liner-back space. In addition, the effects on damping of mean flow past the liner high wave amplitude, wave frequency, and the angle of incidence between the wave and the axis of the liner hole were evaluated. The damping devices were mounted in the cylindrical test cavity. The damping coefficients of the standing waves were measured by both transient and steady-state techniques and then compared with results from a set of theoretical and empirical equations. These equations were based on the assumption that a perforated liner behaves as an array of Helmholtz resonators. There was no quantitative correlation between the experimental and theoretical results; the trends in damping caused by changes in geometrical and wave parameters, however, were generally predictable. The results that did not compare qualitatively with theoretical predictions involved frequency—hole spacing—flow velocity interaction, increase in tangential mode damping with longitudinal partitioning of the liner-back space, and absorption of resonators with an angle of incidence other than 0° between wave direction and resonator neck. Author

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N67-15410# System Development Corp., Santa Monica, Calif.
INFORMATION PROCESSING POTENTIALS IN LARGE-SCALE OPERATIONS Summary Report, Oct. 1962–Jun. 1966
Beatrice K. Rome and Sydney C. Rome 18 Jul. 1966 42 p refs
(Contract AF 19(638)-5166)
(TM-1128/100/00; AD-640591) CFSTI: HC $3.00/MF $0.65

In the study of large organizations, the information, communication, and governing processes have been extremely difficult to formulate. Towards such a formulation, the strategy of the Leviathan studies has been to pursue two lines of attack--theoretical formlization and computer-based simulation. By these means, Leviathan research has studied the interrelationships between (1) executive policy making and control and (2) system performance of large organizations, within (3) experimentally controlled laboratory environments. In answer to the challenge of markedly enhanced computer capabilities just now being made available, practical and theoretical advances have been made in formalizing the communication and governing process in large organizations. These advanced formulations and their significance are explained. Author (TAB)

N67-15520# Argentina. Comision Nacional de Energia Atomica, Buenos Aires. Departamento de Metalurgia
STRATEGY OF METALLURGICAL RESEARCH IN LATIN AMERICA [ESTRATEGIA DE LA INVESTIGACION METALURGICA EN LATINO AMERICA]
Jorge A. Sabato *In its* 1st Latin Am. Conf. on Process Met. and Metal Working, Vol. II Aug. 1966 7 p In SPANISH; ENGLISH summary (See N67-15501 06-17) CFSTI: HC $3.00/MF $0.65

Generalized remarks are summarized on methodology, and economic planning and development of metallurgical research in Latin America. The impact of metallurgical research on the economy of developing countries, and the possibility of establishing priorities in relation to national needs are also briefly sketched. Transl. by R.Ll.

N67-15521 Argentina. Comision Nacional de Energia Atomica, Buenos Aires. Departamento de Metalurgia
OBJECTIVES OF REGIONAL COLLABORATION ON TECHNOLOGICAL SEARCHING [OBJETIVOS DE UNA COLABORACION REGIONAL EN MATERIA DE INVESTIGACION TECNOLOGICA]
Jorge A. Sabato *In its* 1st Latin Am. Conf. on Process Met. and Metal Working, Vol. II Aug. 1966 5 p In SPANISH; ENGLISH summary (See N67-15501 06-17) CFSTI: HC $3.00/MF $0.65

This abstract of the last metallurgical conference session recapitulates program objectives, work accomplished, and proposals for continuing regional cooperation on technological research. Problem areas requiring continuing efforts include: training of technical and professional personnel; utilization of foreign experts on a regional, bilateral, or mutual basis; interchange of senior technical personnel; concrete proposals for cooperative research; and, capital and operating fund requirements. Transl. by R.Ll.

N67-15541# Army Natick Labs., Mass.
FOOD PRESERVATION
K. G. Shea (AEC, Washington, D. C.) and E. S. Josephson *In* Du Pont Large Scale Production and Appl. of Radioisotopes May 1966 23 p refs (See N67-15525 06-22) CFSTI: HC $3.00/MF $0.65

The capability of preserving or extending the storage life of perishable foodstuffs for a rapidly rising population is examined in the light of large-scale radioisotope application. The definition and action of ionizing radiation, as well as beta (or electron) and gamma radiations in food processing are mentioned along with several possible applications and to food treatment of ionizing radiation and specified irradiation doses. Irradiation of fruit to extend its shelf life, successful radiation pasteurization to extend refrigeration limits of seafood and reduce spoilage microorganisms, and the elimination of Salmonellae infections by pasteurizing chicken are reported. Animal feeding of irradiated food, and associated pathological and biochemical studies are being conducted. Preliminary evidence suggests that the higher dose rates which are possible with electron sources may be associated with improved products. R.Ll.

N67-15781*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37–40, VOLUME IV FOR THE PERIOD JUNE 1–JULY 31, 1966. SUPPORTING RESEARCH AND ADVANCED DEVELOPMENT
31 Aug. 1966 309 p refs
(Contract NAS7-100)
(NASA-CR-81207; JPL-SPS-37-40, Vol. IV) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Papers concerning research in guidance and control, engineering mechanics, environmental simulation, propulsion, space sciences, and telecommunications are presented. For individual titles see N67-15782–N67-15829.

N67-15981*# TRW Systems, Cocoa Beach, Fla.
EXPLOSIVE SAFETY EXECUTIVE LECTURE SERIES Final Report
Jun. 1965 152 p
(Contract NAS10-2189)
(NASA-CR-81250) CFSTI: HC $3.00/MF $0.65 CSCL 13L

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7. SPECIAL PROBLEMS OF LIQUID PROPELLANTS, PART I L. T. Dombras 11 p (See N67-15988 06-27)
8. SPECIAL PROBLEMS OF LIQUID PROPELLANTS, PART II G. N. Woodruff 5 p (See N67-15989 06-27)
9. PROCEDURES—THE CORNERSTONE OF SAFETY, PART I G. J. Bryan and J. Larks 9 p (See N67-15990 06-34)
10. STATIC ELECTRICITY AND LIGHTING HAZARDS, PART II G. J. Bryan 9 p (See N67-15991 06-03)

N67-15982*# TRW Systems, Cocoa Beach, Fla.
TOP MANAGEMENT RESPONSIBILITIES, PART I
G. J. Bryan *In its* Explosive Safety Executive Lecture Ser. Jun. 1965 12 p (See N67-15981 06-34) CFSTI: HC $3.00/MF $0.65

The responsibilities of top management in the fields of ordnance and propellant safety are outlined. Two basic guidelines to a realistic ordnance safety program are proposed: no hazardous operations should be performed and any deviation from this rule must be approved by top management. Guides are given to aid in the definition of a hazardous operation. Factors involved in management approach are considered, including discharging of responsibilities, organization, leadership, and monitoring and probing. The performance of the duties of the safety division is discussed, and consideration is given to the following aspects: training and indoctrination, safety planning, procedures, monitoring of operations to detect safety problems and determine whether safety procedures are being adequately performed, technical liason with internal and external organizations on safety matters, facilities and equipment, and reporting of accidents. L.E.W.

N67-15990*# TRW Systems, Cocoa Beach, Fla.
PROCEDURES—THE CORNERSTONE OF SAFETY, PART I
G. J. Bryan and J. Larks *In its* Explosive Safety Executive Lecture Ser. Jun. 1965 9 p (See N67-15981 06-34) CFSTI: HC $3.00/MF $0.65

Well-prepared and adequate procedures are required for safe and effective operation of any test program. Developing the step-by-step procedure involves the identification and naming of the tasks, assignment of the responsibility, and actual writing of the working document. A so-called Fog Index, recommended to evaluate the clarity of the written procedures, is presented to gauge the readibility of the material. Means of calculating this index, which roughly corresponds to the number of years of schooling required to read and understand a passage, are detailed. The resulting index should not exceed 12, and should generally be in the 8 to 10 bracket. Review and approval of the written procedures is discussed, as are their revisions and enforcement. M.W.R.

N67-16001*# National Academy of Sciences-National Research Council, Washington, D. C.
PROGRESS IN SCIENTIFIC RADIO: FIFTEENTH GENERAL ASSEMBLY OF THE INTERNATIONAL SCIENTIFIC RADIO UNION
1966 378 p refs Gen. Assembly held in Munich, 5–15 Sep. 1966
(Contract NSR-09-012-907)
(NASA-CR-81249; Publ.-1468) CFSTI: HC $3.00/MF $0.65 CSCL 20N

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2. REPORT OF THE SECRETARY-GENERAL E. Herbays p 7–11
3. ADMINISTRATIVE ACTIONS OF THE ASSEMBLY Henry G. Booker and W. J. G. Beynon p 13–27
4. GENERAL SESSION—ALL COMMISSIONS p 39–47 (See N67-16002 06-23)
5. RADIO STANDARDS AND MEASUREMENTS p 49–94 refs (See N67-16003 06-23)
6. RADIO PROPAGATION IN NON-IONIZED MEDIA p 95–137 (See N67-16004 06-07)
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11. RADIO ELECTRONICS p 347–371 (See N67-16009 06-09)

N67-16075*# Library of Congress, Washington, D. C. Aerospace Technology Div.
FOREIGN SCIENCE BULLETIN, VOLUME 2, NUMBER 11 A Monthly Review of Selected Foreign Scientific and Technical Literature
Nov. 1966 84 p refs

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4. TRENDS IN SOVIET GEOACOUSTICS p 27–28 ref
5. USE OF ULTRASONICS IN STUDYING THE STRATIFICATION AND ELASTIC-WAVE VELOCITY IN OCEAN-BOTTOM SEDIMENTS p 29–30 ref
6. A RUBY MASER OPERATING AT 40°K p 31–32 ref
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8. SOVIET WINGED, AIRBREATHING AEROSPACE TRANSPORTER DOCTRINE p 34–35 refs
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10. HEAT SHIELD EFFICIENCY OF PHENOLICS p 38–39 ref
11. THERMAL FACTORS IN THE GROWTH OF FLUCRITE CRYSTALS p 40–41 ref
12. CONFERENCE ON SUPERCONDUCTORS p 42–45 ref
13. BIONICS AND INSTRUMENT MANUFACTURE p 45–47 ref
14. THIRD ALL-UNION CONFERENCE ON PHYSICS OF ELECTRONICS AND ATOMIC COLLISIONS p 47–57 ref
15. SYMPOSIUM ON DEEP-SEATED PROCESSES p 57–63 ref
16. MOSCOW ENGINEERING PHYSICS INSTITUTE SCIENTIFIC CONFERENCE p 64–66 ref
17. SCIENCE PERSONALITIES p 67–69 ref
18. BOOK REVIEWS p 70–77

N67-16114*# Texas A&M Univ., College Station. Dept. of Industrial Engineering.
THE DETERMINATION OF EMPIRICAL AND ANALYTICAL SPACECRAFT PARAMETRIC CURVES—THEORY AND METHODS Third Progress Report
1 Nov. 1966 61 p refs
(Grant NGR-44-001-027)
(NASA-CR-80921) CFSTI: HC $3.00/MF $0.65 CSCL 05A

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1. DYNAMIC PROGRAMMING ALGORITHM FOR DETERMINING 'BEST FIT', PART I G. Self 10 p (See N67-16115 06-34)
2. QUANTIFICATION OF SUBJECTIVELY DETERMINED DATA IN THE FORMULATION AND UTILIZATION OF MATHEMATICAL MODELS, PART II G. Self 17 p refs (See N67-16116 06-34)
3. WEIGHTED ESTIMATION OF RUN-OUT COSTS, PART III S. P. Brown 32 p (See N67-16117 06-34)

N67-16115*# Texas A&M Univ., College Station. Dept. of Industrial Engineering.

DYNAMIC PROGRAMMING ALGORITHM FOR DETERMINING 'BEST FIT', PART I

Glen Self *In its* The Determination of Empirical and Anal. Spacecraft Parametric Curves—Theory and Methods 1 Nov. 1966 10 p (See N67-16114 06-34)

An algorithm for determining the best fit or best combination of single estimating relationships into a composite estimating relationship is extended to include an example illustrating the mechanics of the algorithm. In the expansion, the problem (1) has any number of terms that were to be combined into a single function under the constraint that the sum of the weights used should approximate one; (2) is further restricted by a small number of data points; (3) has an inherent flexibility so that consecutive last terms can be deleted and still provide the optimum solution without recomputation; (4) provides for a built-in sensitivity whereby the effect of variation in the weightings can be evaluated; and (5) uses the minimum sum of squares criteria as a basis for determining optimum weighting of the terms. As the stages correspond to the terms which are being combined, the recursive relation of dynamic programming is developed. The solution for the example problem is tabulated. M.G.J.

N67-16116*# Texas A&M Univ., College Station. Dept. of Industrial Engineering.

QUANTIFICATION OF SUBJECTIVELY DETERMINED DATA IN THE FORMULATION AND UTILIZATION OF MATHEMATICAL MODELS, PART II

Glen Self *In its* The Determination of Empirical and Anal. Spacecraft Parametric Curves—Theory and Methods 1 Nov. 1966 17 p refs (See N67-16114 06-34)

An overall review is presented on the research which is directed toward using a basically statistical appraoch to the problem of resolving questions of convergence, distinguishability or discrimination among subjectively assigned values, and the formulation of mathematical models. Problems connected with developing these models are assessed, with attention focused on an approach to provide for a logical and consistent model structure in which all available data will be used, with provisions for revision as more data becomes available and for incorporating the available expertise. In discussing the limited data case, consideration is given to combining estimators, evaluating interaction through the use of expertise, estimation of run-out costs for spacecraft programs, and the collection and analysis of subjectively determined data. M.G.J.

N67-16117*# Texas A&M Univ., College Station. Dept. of Industrial Engineering.

WEIGHTED ESTIMATION OF RUN-OUT COSTS, PART III

Sidney P. Brown *In its* The Determination of Empirical and Anal. Spacecraft Parametric Curves—Theory and Methods 1 Nov. 1966 32 p (See N67-16114 06-34)

An explanation is presented on a computer program for use in computing run-out costs for subsystems under development. As the subsystems of the uncompleted project would not necessarily follow the curve of the same subsystem as the completed project, it is hypothesized that the best fitting curve should be chosen from among a population of curves of completee subsystems. The curve which most closely approximates the available data should be used to estimate the run-out cost. The three basic phases in the method of estimating these run-out costs are identified as determining (1) a polynomial to fit each population curve; (2) the best fitting curve among the population to the uncompleted subsystem data; and (3) cost data points for projecting the run-out cost. M.G.J.

N67-16317# Polish Academy of Sciences, Warsaw. Committee for the Peaceful Uses of Nuclear Energy.

RADIOMETRIC INVESTIGATION OF THE FLOW OF SAND FILLING IN MINE PIPELINES

K. Korbel, J. Lasa, and K. Przewlocki *In its* Nukleonika, Vol. VIII 1966 p 716–727 refs (See N67-16221 06-06) CFSTI: HC $3.00/MF $0.65

In the paper measurements of the flow velocity for sand and water in the mining pipe-lines have been described. The measurements have been done by labeling separately of both components, using radioactive sodium ^{24}Na. Simultaneously temporary density of the mixture, by means of the radioisotope gauge has been recorded. In the limits of the measurement error velocities of both components were the same. Also bottom deposit in the pipe-line has been observed, in the range of velocities considerably exceeding the values given by the theory. Author

N67-16338# RAND Corp., Santa Monica, Calif.

USE OF COST-ESTIMATING RELATIONSHIPS IN THE AIRFRAME INDUSTRY

M. A. Margolis Oct. 1966 10 p Prepared for Presentation at the 13th Natl. Meeting of the Operations Res. Soc. of Am., Durham, N. C.

(P-3472; AD-642235) CFSTI: HC $3.00/MF $0.65

The paper described a survey of cost-estimating procedures employed by the airframe industry. The use of statistical techniques was found to be surprisingly extensive, although considerable differences were found to exist among airframe firms insofar as the nature of the techniques in use. These differences include their functional forms, the explanatory variables employed, and the level of detail at which they are employed. In general, the current use of statistical procedures by airframe cost estimators is not the product of the increase in the volume of detail demanded by the government over the last five years, but is considerably more deeply rooted, extending back prior to World War II. In addition to being less expensive to apply, these procedures appear to be superior to industrial engineering procedures in accounting for the significant variability in the fabrication and assembly of successive production units which has been so characteristic of the airframe industry. Author (TAB)

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